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With the advent of gender-neutral recruiting and the admission of females into more technical and non-traditional occupational fields, the Navy training experience with females has changed. The Navy believes that attrition in women is due to the fact that women are immersed in an environment dominated by men and that resulting stressors affect the women's ability to perform critical tasks, such as firefighting.

The Navy believes that instructional interventions can improve women's job performance, decrease their stress, and improve their self-esteem. This purpose of this research effort is to determine the effectiveness of two instructional interventions on stress, self-efficacy, and job performance of female Navy recruits in firefighting training.

The scope of the research project includes analyzing the training requirements, designing and developing the interventions and measurement instruments, collecting and evaluating data, and reporting the outcomes.

This report presents a detailed summary of scientific issues and accomplishments for year one of the study, which include the analysis of the training requirements, preparation of the measurement instruments, development of the treatment plan, and design of the interventions. During years two and three, the instructional interventions will be developed and data will be collected, analyzed and reported.

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Imelda Idar 10/11/97

PI - Signature Date

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INTRODUCTION

Subject of Study

As an indicator of the changes in the Navy training experience, from FY 90 to FY 97, recruit attrition has increased from a low of 8.9 percent to a high of 13.49 percent. Data analysis identifies that for females, attrition was most accounted for by psychometric causal factors. Traditionally, the Navy training and operational environments have been male-dominated, leading to stress for women who are training and working in environments in which the well-documented differences between men and women have not been addressed.

The subject of this study is the test of role modeling and advance organizer treatments on factors that increase the level of stress for recruits, especially female recruits. These factors include low expectation of success in highly stressful work situations; unfamiliarity with technical information; lack of experience serving in the various roles required of members of teams; and differences in communication, teamwork, and leadership strategies between men and women. Improved performance is the ultimate goal of the training interventions. The significance of stress, efficacy, and emotion lies in their impact on performance and the fact that these are the modifiable antecedents of performance difference. The interventions are expected to reduce stress by providing an introduction to the task elements of the job. Increased self-efficacy and reduced negative affect are expected to follow from this learning. Improved job performance is expected to derive from reduced stress and strain, including improved self-efficacy.

The study is conducted around the parameters of firefighting training conducted at the Recruit Training Command (RTC) in Great Lakes, Illinois. The study addresses the Defense Women's Health Research Program (DWHRP) concerns with operational effectiveness for mission accomplishment and psychological health and well-being. Attributes of shipboard firefighting are related to the performance of females under stress. Firefighting is representative of physically demanding jobs that make males doubt the ability of females to meet performance requirements. Thus, firefighting training is a particularly useful model for studying the performance of female sailors under stress.

Purpose of Study

The Navy believes that innovative instructional strategies and technologies can be developed to improve women's job performance, decrease their stress, and improve their self-esteem. Research and development conducted by Gray (1992) and Tannen (1990, 1994) support the perspective that instruction should either accommodate both men and women or provide women with skills to succeed in male-dominated training environments. Stress from environments in which these factors have not been addressed is well documented in the literature. Therefore, the Navy has made a commitment to investigate instructional approaches and associated instructional technologies that would mitigate this stress and lead to increased female success in recruit training. The purpose of this research and development effort is to determine the effectiveness of two advanced technology instructional strategies on stress, self-efficacy, and job performance of female Navy recruits in firefighting training. Perception that females cannot perform firefighting tasks reinforces the sexist attitude that women do not belong at sea. When forming a firefighting team, no one wants team members who are weak, are afraid, believe they cannot perform, or do not know the correct procedures. It is important that both males and females believe that females can be effective members of firefighting teams. With these considerations in mind, three major null hypotheses will be tested:

1. Providing women with models of effective performance will not reduce stress or strain and will not improve job performance.

2. Providing women with aids to structure the learning process will not reduce stress or strain and will not improve job performance.

3. Providing men and women with models of effective performance will not result in male/female attitudinal changes.

The proposal for this study listed a null hypothesis which stated that position within the hierarchical team structure of firefighting will not affect women's experience of stress or strain or their firefighting performance. This hypothesis has been replaced by the third null hypothesis above. The hierarchical position factor was dropped after it was discovered that hierarchical interplay was not a factor in recruit firefighting. Unlike the situation in the fleet, where team hierarchy comes into play with the requirement to coordinate several firefighting teams, each firefighting team in basic training operates independently of other teams. Therefore, there are no hierarchical roles to coordinate efforts. This type of training apparently is not needed for recruits, because the coordination roles in the fleet would be handled by senior personnel with advanced damage control training and certification. Moreover, since female and male recruit divisions are intermingled for all training, separating the sexes so that just the women would receive the experimental treatments would add a scheduling burden for RTC personnel.

Scope of Research

The scope of the project includes benchmarking stress levels, analyzing the training requirement, documenting the learning objectives for the instructional interventions, preparing the measurement instruments, designing and developing the two interventions, and applying the interventions to recruits to determine if the interventions reduce stress, improve performance, and change attitudes of male and female recruits in firefighting training. The two interventions are the Role Modeling treatment and the Advance Organizer treatment. Interventions will be applied to "paired" divisions and all-male recruit divisions. "Paired" divisions contain one male division and one female division.

Background of Previous Work

This is the first year of this project and there is no previous work on which to report.

EXPERIMENTAL METHODS, ASSUMPTIONS, AND PROCEDURES

Experimental Methods

During year one of this project, the research team analyzed the training needs, requirements, and problems associated with firefighting training of male and female recruits. The research team developed the instructional treatment plan, finalized the research design, and designed the instructional interventions. Research was conducted in the areas of cognitive science, learning theories, team competencies, communications, safety, teamwork, and leadership skills, team process measures, and gender differences in personal skills development to provide a theoretical basis for the instructional approach taken in the two treatments to achieve the desired effects of reducing stress and strain and changing attitudes in male and female recruits. The following pages describe the results of the year one work efforts.

Analysis of Training Requirements

The team analyzed the content of the current firefighting course; observed academic and hands-on training; and collected lesson plans, slides, student guides, and other content data. The team performed a

detailed analysis of the existing firefighting training at the Recruit Training Command (RTC). Instructors, recruit division commanders (RDCs), and students were interviewed to determine specific academic problem areas; desired attitudes, knowledge and skills; and male and female performance in academic tests and hands-on training. Learning objectives and programs of instruction for the academic and hands-on components of firefighting and basic seamanship were gathered and analyzed. Objectives for communication, safety, leadership, and teamwork skills were developed after analyzing RTC requirements and related research. A report describing the specific training needs in the area of firefighting at the RTC was developed and relevant data was incorporated into the Instructional Treatment Plan. This Training Requirements report appears as Appendix A of this document.

Development of Measures to Assess Stress, Efficacy, and Performance

Record-keeping procedures at the RTC were analyzed to determine the most efficient means of obtaining information on mental ability. Performance assessment procedures for firefighting at RTC and at firefighting school in San Diego were reviewed and evaluated.

Additional sources of relevant information were identified and analyzed. Interviews were conducted with instructors, RDCs, and trainees to determine what factors in firefighting training gave the recruits the most difficulty. Interviews were conducted with recruits to characterize stresses, self-perceptions, and emotional reactions to firefighting training. Female and male recruits were interviewed separately and together to determine attitudes with regard to women's ability to perform in firefighting training. Interviews were semistructured, that is, a questionnaire containing open-ended questions was used to identify trainee concerns and identify RDC and instructor perceptions of stresses on male and female recruits. The results of these interviews are provided in Appendix A. During the task analysis effort, the research team reviewed record-keeping procedures at the RTC to determine the most efficient way of obtaining information on mental and physical ability of the students. The team also reviewed and evaluated performance assessment procedures for firefighting for psychometric adequacy as criteria. The initial procedures for assessing the effects of firefighting training were combined to form an Initial Firefighting Stress Questionnaire.

The steps taken to develop and revise the Initial Firefighting Stress Questionnaire were:

1. An initial 98-item questionnaire (33 stress items, 65 mood items) was constructed.
2. Confirmatory factor analyses of archival data reduced the questionnaire to 28 items. These 28 items, which measure self-efficacy and perceived stress, include 15 items from previous scales, two items formed by splitting what had been a compound item, and four new stress items based on information from recruits.
3. The Committee for the Protection of Human Subjects approved a protocol to administer the stress questionnaire to recruits.
4. A request for permission to administer the questionnaire was submitted to the Office of the Chief of Naval Operations (OCNO) as required by current policy. Details for the first two steps are given in Appendix B. The Initial Firefighting Stress Questionnaire is provided in Appendix B-1. Copies of the research protocol and the OCNO request will be provided if needed.

Contingent on receipt of OCNO permission to administer the questionnaire, stress data will be collected in November 1997. The stress measurement model will be verified by applying measurement models developed in this year's work to the data. Mood measures are not included in this verification because U.S. Navy recruits provided the data used in this year's confirmatory analyses of mood (Appendix B). Stress and mood measures will be combined in the final Stress Evaluation Profile. A Preliminary Stress Assessment Profile is presented in Appendix B-2. It contains the self-efficacy and perceived stress items that are expected to be included as a result of the collection of stress data in November, as well as

mood/affective stress items. The Stress Evaluation Profile will be finalized in November or December depending on the timing of the data collection.

Development of the Treatment Plan

Upon completion of the training requirements analysis, the research team developed the Treatment Plan. The Treatment Plan provides a detailed description of how the interventions will look (the media strategy) and how they will function (the interactive design strategy). The Treatment Plan describes the research that informed the design of the treatments. The Treatment Plan describes the target population in terms of required experience level, recruit knowledge and education, and student characteristics in relation to job expectations. The Treatment Plan provides a training hierarchy list, objectives, performance factors, and qualification levels for terminal and enabling objectives. The Treatment Plan was submitted to the training specialists at RTC to ensure that the technical data is correct and that the RTC can support provision of the treatments to the recruits during the study. The contents of the Treatment Plan are presented in the section titled "Results and Discussion" in this report.

Design of the Interventions

Once the Treatment Plan was reviewed and approved, the research team began detailed design of the interventions. The design was captured on storyboards. After completion of the draft Advance Organizer storyboard, the research team met with the RTC instructors to validate the content. The research team also took photographs and collected videotapes for use in development of the Advance Organizer treatment. The design of the Advance Organizer treatment was revised to reflect the desire of the team to incorporate intelligent tutoring into the treatment. It is believed that in addition to the learner control in the CBT, the intelligent tutoring approach will provide learning experiences that are specifically geared to the different cognitive learning styles of men and women indicated by the research. A discussion of cognitive learning styles and the relevant instructional strategies is provided in this document. The research team developed the content of the Role Modeling treatment with the instructors and damage control (firefighting) experts and developed a storyboard for the Role Modeling treatment. Both storyboards have been submitted to Dr. Imelda Idar, who is coordinating the Navy review of these documents.

Collection of Data

In years two and three, data will be collected and analyzed. The Stress Evaluation Profile will be paper-based. The rationale for this change from a computerized test is provided in the Research Design section of this report. A meeting with RTC is scheduled to determine whether a computerized or paper-based questionnaire will be less intrusive for the RTC schedule.

Assumptions

Navy training experience reveals that the acculturation process is stressful. The data makes it evident that females and males cope with that stress differently. Males exhibit more antisocial behavior than females. These assumptions are based on interviews conducted at RTC which are included in Appendix A; academic test results data from RTC; results of psychological testing at RTC, and recruit data from the Navy Integrated Training Resources and Administration System (NITRAS). The skewdness of the data, coupled with results of recruit and division commander interviews, leads to some assumptions. These assumptions are categorized as stressors which can be ameliorated by role modeling, interactive instructional strategies, and attitudinal changes.

Role Model Assumptions

- Cultural/ethnic/gender diversity impacts communication. Just as there are differences in the ways in which males and females communicate, such as the differences in ways of exhibiting confidence, giving orders, providing feedback and criticism, directness, and voice, there are also significant differences in the ways in which members of different cultural and ethnic groups communicate. One obvious example is the different meaning of maintaining eye contact during communication from superiors to subordinates. The implications of gender diversity in communication styles are discussed more fully in this report in the section titled "Research Supporting Development of the Role Modeling Treatment."

- There is gender bias in the way that male RDCs treat female and male recruits, i.e., role modeling differs for males and females. Leadership strategies compensate for gender differences. The question remains whether those compensation strategies are beneficial to the recruits or do they perpetuate/exacerbate gender differences. For example, some RDCs encourage males in paired divisions (one male and one female division paired for training and most other activities) and integrated divisions (one division containing both males and females) to "look after" the females in their divisions. The paired divisions are often called "brother/sister" divisions. It is a belief among recruits that males who are in "brother/sister" and integrated divisions have an easier recruit experience because the RDCs push the whole group less hard.

- Female recruits are different than male recruits emotionally. They cope with stress using gender-driven strategies. Female recruits are more likely to cry, which is interpreted as "breaking down." When they do "break down" the RDCs are likely to let up the pressure on the paired divisions. Hence the interpretation that females change the bootcamp experience for males who are members of integrated and paired divisions.

- Team building behaviors reflect gender differences. Females identify problems in teamwork because they don't have time to talk and get to know each other, i.e., "bond," before being forced into situations that require teamwork. They feel that teamwork suffers from this lack of time to bond. Males are more comfortable with and more likely to use the chain of command, which tends to strengthen the teams. Research findings on gender differences in team building behaviors are presented in Appendix A.

Instructional Strategies Assumptions

- Current instructional strategies are heavily biased with male analogies. Since currently there are no male instructors in firefighting training at RTC, it is easy to understand how the details and analogies that are provided by instructors to make the material more understandable, would be gender-biased. Films, especially those used for motivation, are old and contain all male firefighting teams. Research results, presented in the discussion of the Advance Organizer in this document, indicated that females are more likely to prefer instructional situations that emphasize teacher-student interactions, human interactions, provision of the "big picture," and hands-on instruction. The primary instructional mode, classroom lecture, does not support these traits.

- Males and females have not had the same prior experiences which would affect how they are able to assimilate new information. For example, many males are more comfortable with technical information than are females The amount of technical material that comprises the academic component of firefighting training has decreased dramatically in the past year. However, there are still some areas which males may find easier to understand, such as how an eductor works.

Attitudinal Changes Assumptions

- From the very start, women and men differ in their attitude toward their ability to fight and their self-confidence about learning technical material. There are no female instructors in firefighting training currently at RTC. There are very few damage control specialists in the Navy who are female. Few males have served with females who are damage control specialists. There is still some fear among male Navy personnel that women won't be able to fight fires.

- Females are a minority in a highly male dominated organization. For the period October 1, 1996 to August 31, 1997, female accession was only 13.68% of the total. Therefore, all females can expect to be in a minority in the Navy. Since women have only recently been admitted to certain male-dominated occupational fields, females who choose these fields can expect to be in an even smaller minority.

Procedures

The procedures for the study were drawn from the systems approach to training development and the instructional system development model. Evaluation is a central function that takes place at every phase. The approach began with analysis of the training requirements and review of relevant research data which supports a particular approach to designing the instructional interventions. An analysis report was prepared which described the target audience, the learning objectives for firefighting training, and the overall training requirements. Once analysis was completed, the instructional interventions were designed and the measures for assessing stress, efficacy, and performance (the research design) were finalized. An instructional treatment plan was prepared which described the relevant research findings and the specification for the instructional interventions.

During the second year of the study, the instructional interventions will be developed, and the data collection effort will begin. During the third year, the data collection effort will be completed and the data will be analyzed and reported.

RESULTS AND DISCUSSION

The results of year one activities were the analysis of training requirements, review of the literature for relevant research findings which support the instructional interventions, finalization of the research design for the study, and design of the instructional interventions. No empirical data was collected during year one.

Target Population

Description of Bootcamp

Prior to fiscal year (FY) 1995, the Navy maintained three Recruit Training Commands—Orlando, Florida; San Diego, California; and Great Lakes, Illinois. Orlando was the only command to train female recruits. Until FY 94, all training was conducted in a segregated manner. The curriculum and standards were the same for both males and females. In FY 95, piloting of gender-integrated training began as efforts commenced to fully integrate the Navy. Those efforts were then concentrated at Great Lakes as it became the only site to train Navy enlisted non-prior service accessions (Navy recruits). Women are placed in either "paired" divisions, which contain one male and one female division paired for training and most other activities, or "integrated" divisions. An integrated division is one division which contains both males and females and is formed to allow recruits to participate in activities such as band and drill

teams. Members of these integrated divisions tend to have higher Armed Forces Qualification Test (AFQT) scores than other divisions.

The current Recruit Training curriculum is 9.3 weeks in length. It consists of a 24-hour schedule that allows for eight hours of sleep and a stringent personal hygiene routine. The focus of the training is to transition the accession from civilian to military life. It combines a series of team building and personal skills exercises within the context of shipboard environment. The curriculum also orients and instructs the recruits on military skills such as marksmanship, firefighting, damage control, swimming, and nuclear and biological warfare. It immerses recruits in an environment which improves their physical fitness—marching, running, situps, confidence course, and damage control Olympics. All exercises and instruction are conducted in a structured and disciplined manner but with positive reinforcement.

Recruit Training also functions as a screening process. Upon arrival, recruits are tested for drug and alcohol abuse. On the first day, they are put through two screens—Moment of Truth, which reviews all contract options and ferrets out inconsistencies and illegalities, and Biological Evaluation of Troops (BEST), a psychological assessment to separate individuals with severe personality disorders and/or psychiatric problems which preclude successful completion of enlistment. Recruits also undergo rigorous medical evaluation that includes testing for color blindness, hearing acuity and physical abnormalities.

Characteristics of the Target Audience

At the same time that all recruit training was moved to Great Lakes and gender-integrated training was instituted, the Navy carried out an intensive review of training attrition. Attrition experienced at boot camp is especially damaging to the Navy because recruits are not reassigned but are actually separated from the Navy. The efforts were not new, having begun in FY 89. However, the Navy was directing its approach on a macro level, linking recruiting, base environment, leadership, and training factors. Also, a deeper understanding of attrition causal factor necessitated that more detailed attrition codes be used. The evolution of these codes to the current format and the myriad of training initiatives which have been executed since FY 89, often makes long-term comparison of recruit demographic data difficult. For purposes of this study, statistics from the FY 97 cohort are compiled to provide a recruit profile. This information was derived from the Navy Integrated Training Resources and Administrative System (NITRAS) and covers the period from October 1, 1997 through August 31, 1997.

During the period October 1, 1997 - August 31, 1997, a total of 43,092 accessions entered Navy RTC, Great Lakes. Of those, 86.3 percent were male and 13.7 were female. In general, both the male and female recruit populations are similar. The average age of the males is 20.91 and the females is 20.96. The mean education level for females is 12.11, slightly higher than that of the males, 11.94. (See Table 1.)

In order to enter the Service, accessions must take the Armed Services Vocational Aptitude Battery (ASVAB). Results are the benchmark which determine the accession's occupational direction. A subset of the ASVAB is the Armed Forces Qualification Test (AFQT). It consists of three line scores from the tests on mechanical knowledge, arithmetic reasoning, and word knowledge. The AFQT correlates positively with the psychometric construct of "g," i.e., it has a strong correlation to general intelligence. It is used as a barometer of accession quality along with the educational level. The mean AFQT for females was 59.28 and for the males, 60.63. Table 1 shows demographic data for the period from October 1, 1996 to August 31, 1997.

Table 1. Demographic Data on Accessions

	Number Enrolled	Percentage Enrolled	Average Age	Average Education	Average AFQT	Percentage Single
Male	37,197	86.3%	20.91	11.94	60.63	97.65%
Female	5,896	13.7%	20.96	12.11	59.28	95.39%
TOTAL	43,092	100%	11.97	60.45	0.13	97.34%

The female cohort had a higher minority composition than the male cohort. Of the 5,895 female accessions, 56.5 percent were white and 44 percent were minority. Of the 37,197 male accessions, 61.5 percent were white and 38.5 percent were minority. This difference has significant implications for leadership styles and communication strategies.

The Hispanic representation in both populations was the same. Among male accessions, 10.9 percent were Hispanic. Among female accessions, 10.8 percent were Hispanic. The black minority composite was significantly different. Among male accessions, 17.7 percent were black, while among female accessions, 24.7 percent were black. Table 2 shows accession data by gender/ethnic/racial groups for the period from October 1, 1996 - August 31, 1997.

Table 2. Ethnic/Racial Grouping of Male and Female Accessions

	Male Accessions	Female Accession	Percentage of Male Accessions	Percentage of Female Accessions
American Indian	1,052	206	2.8%	3.4%
Asian or Pacific	1,864	240	5.0%	4.0%
Black	6,583	1,460	17.7%	24.7%
Hispanic	4,063	639	10.9%	10.8%
White	22,878	3,303	61.5%	56.5%
Other	757	47	2.0%	0.8%
TOTAL	37,197	5,895	100%	100%

Reasons for Attrition

Close scrutiny was given to attrition data, because it provides insight into the problems and strengths of boot camp. The data also gives focus to the development of training and intervention efforts. There is no academic attrition at bootcamp by order of the Chief of Naval Operations. As a result, all attrition is dichotomized into two broad categories, motivational non-academic attrition and non-motivational non-academic attrition. The difference lies in the behavior exhibited by the recruit as he/she is evaluated and provided with remediation prior to separation. In motivational non-academic attrition, the recruit clearly does not want to stay in the Navy. He/she does not cooperate with staff to improve performance. In the case of non-motivational non-academic attrition, the recruit makes every effort to overcome the obstacles. Often, the recruit appeals for a waiver.

In a general review of attrition, the conclusion can be made that females are less likely to attrite. While the total recruit population experienced a separation rate of 13.9 percent, the rate was 14.2 percent for males and 11.7 percent for females. These figures are based on FYTD data provided by NITRAS for accession and attrition. From these figures it appears that females are doing better than males. However, when the reasons for attrition are examined, a telling picture emerges.

Motivational Non-Academic Attrition

NITRAS provides data on causes of attrition. For this data, attrition equals attrites divided by student flow. According to this data, 4.06 percent of male recruits attrited due to motivational non-academic causes and 5.45 percent of female students attrited for motivational non-academic reasons. The largest differences are in medical administrative attrition. For administrative attrition (failure to adapt to military life), 0.25 percent of male recruits attrited and 0.14 percent of female students attrited. Males were more overt in displaying their inability to adapt to military life. Female inability to cope was exhibited through medical problems. The data shows that 3.60 percent of male attrition was due to medical problems while 5.11 percent of female attrition was due to medical problems. (See Table 3.)

Table 3. Motivational Non-Academic Attrition

Motivational Non-Academic Attrition	Males - Percentage Of Total	Females - Percentage Of Total
1. Motivation (Negative Navy/Military Attitude)	0.01	0.00
2. Administrative (Non-Adaptation to Military Life)	0.23	0.14
3. Medical (See Table 4)	3.61	5.11
4. Legal (See Table 5)	0.19	0.16
5. Miscellaneous (Contract or Obligation - Active Duty)	0.01	0.01
TOTAL	4.06	5.45

Female attrition was almost double that of males for preservice psychiatric problems, personality disorders, and situation reaction disorders. (See Table 4.) Females tended to desert at a slightly higher rate than males. (See Table 5.)

Table 4. Medical (Motivational Non-Academic)

Motivational Medical	Males – Percentage Of Total	Females – Precentage Of Total
1. Orthopedic - Preservice	0.50	0.32
2. Orthopedic - Service Connected	0.02	0.00
3. Podiatry - Preserve	0.07	0.05
4. Podiatry - Service Connected	0.01	0.00
5. Psychiatric - Preservice	0.97	1.72
6. Psychological - Personality Disorders	1.21	1.51
7. Psychological - Situation Reaction	0.83	1.51
TOTAL	3.61	5.11

Table 5. Legal (Motivational Non-Academic)

Motivational Legal	Males - Percentage Of Total	Females - Percentage Of Total
1. Declared Deserter	0.03	0.04
2. Misconduct	0.16	0.12
3. PRT Failures	0.00	0.00
TOTAL	0.19	0.16

From these data, an assumption can be made that the female stress level is higher than that of males. This assumption is based on the fact that the motivational non-academic attrition was higher for females than for males and the fact that most of this attrition for females was due to psychiatric/psychological causes.

Non-Motivational Non-Academic Attrition

In general, 8.76 percentage of male attrition was due to non-motivational non-academic attrition, while 7.67 percentage of female attrition was due to non-motivatoinal non-academic attrition. (See Table 6.) Medical and legal reasons under this aegis were similar—2.53 percent for males and 2.93 percent for females, and 0.06 percent for males and 0.07 percent for females respectively. A significant difference lies in fraudulent enlistment—5.87 percent for males and 2.22 percent for females. Males had a tendency to have higher arrest records, were more likely to be drug-dependent, and were more likely to disclose the use of drugs than females. (See Tables 7, 8 and 9.) Interestingly, females had a higher rate of drug use in boot camp than males. In the medical arena, females exhibited higher separation rates for service-connected psychiatric reasons and sleepwalking than males.

Table 6. Non-Motivational Non-Academic Attrition

Non-Motivational Non-Academic Attrition	Males - Percentage Of Total	Females - Percentage Of Total
1. Administrative (Hardship)	0.02	0.05
2. Medical (See Table 7)	2.53	2.93
3. Legal (See Table 8)	0.06	0.07
4. Death	0.00	0.00
5. Physical	0.00	0.00
6. Fraudulent Enlistment (See Table 9)	5.87	2.22
TOTAL NON-MOTIVATIONAL	8.76	7.67

Table 7. Non-Motivational Medical

Non-Motivational Medical	Males - Percentage Of Total	Females - Percentage Of Total
1. Dermatology (Pre-Service and Service Connected)	0.08	0.12
2. ENT (Pre-Service and Service Connected)	0.29	0.32
3. General Surgery (Pre-Service and Service Connected)	0.02	0.04
4. Gynecology (Pre-Service and Service Connected)	0.00	0.16
5. Internal Medicine (Pre-Service and Service Connected)	1.01	1.05
6. Neurology (Pre-Service and Service Connected)	0.25	0.30
7. Non-Aquatically Adapt - Hydrophobic	0.00	0.00
8. Ophthalmology (Pre-Service and Service Connected)	0.37	0.35
9. Other Medical (Pre-Service and Service Connected)	0.19	0.30
10. Psychiatric Suicide Attempts/Ideation (Pre-Service and Service Connected)	0.05	0.05
11. Psychiatric (Service Connected)	0.00	0.02
12. Psychological - Enuresis	0.13	0.04
13. Psychological - Sleepwalking	0.06	0.11
14. Urology (Pre-Service and Service Connected)	0.08	0.07
TOTAL	2.53	2.93

Table 8. Non-Motivational Legal

Non-Motivational Legal	Males - Percentage Of Total	Females - Percentage Of Total
1. Civil Conviction	0.06	0.02
2. Drug Subsequent Screen	0.00	0.05
TOTAL	0.06	0.07

Table 9. Non-Motivational Fraudulent Enlistment

Non-Motivational Fraudulent Enlistment	Males - Percentage Of Total	Females - Percentage Of Total
1. Arrest Record Pre-Service	0.07	0.04
2. Drug Dependent	1.18	0.50
3. Drug Disclosure	0.14	0.05
4. Homosexual Preservice	0.17	0.09
5. Initial Drug Screen (Cannabis)	3.60	1.17
6. Initial Drug Screen (Non-Cannabis)	0.69	0.37
7. Undisclosed Prior Service	0.01	0.00
TOTAL	5.87	2.22

Changes to Academic and Hands-On Components of Firefighting Training

During the analysis of training requirements, the research team discovered various changes to the academic component of the firefighting course which have resulted in an overall increase in recruit scores on the academic tests, and a smaller difference between male and female scores on the academic tests. Changes to the academic component of firefighting training moving firefighting training from week four to week seven of the approximately nine-week boot camp. (It is now at the end of week six.) By the time they begin firefighting training, the recruits are deeper in the acculturation process and the atmosphere of basic training. Recruits indicated that by the last weeks of bootcamp they had more time to study than they had earlier. They are more adapted to the demands of the physical fitness component of recruit training because they are more physically fit.

Highly technical material was removed from the curriculum and tests. Test items are regularly analyzed for suitability and changed as needed. Some recruits received academic tutoring prior to and during firefighting training from RDCs and instructors. Note, although changes have resulted in a greater parity between males and females in the academic portion of the course, the research team found that still more females fail the academic test. This is important because, although recruits are not attrited for academic failure, they can be set back (required to repeat the week of training) up to twice for failing the academic test. In bootcamp, if a recruit fails an academic test once, he or she is allowed to repeat the test. Test result data, provided by RTC for FY 97, shows that 2 percent of male recruits and 3.4% of female recruits failed Test Four, which contains primarily items from the firefighting course, the first time they took it. (Test scores of recruits who were part of integrated divisions were not counted in this data since it is impossible to derive separate male and female scores for these divisions.) If recruits fail twice, they are "set back," i.e., they must repeat a week of bootcamp. In FY 97, females were twice as likely as males to be set back for academic failure in firefighting, i.e., 0.23 percent of males failed Test Four twice and 0.59 percent of females failed it twice.

Throughout the first year of the project, the research team discovered changes to the hands-on component of the firefighting course as well. During the first visit by the research team, there was one hands-on training experience in the firefighting course, which took place in the Damage Control simulator. Recruits observed some procedures and were guided through the performance of others. There were no individual or group scores for hands-on training. On a later visit, the hands-on component of firefighting training had changed. After the guided hands-on exercise which is not scored, recruits participate in an "unguided" Team Training exercise in which they perform the same activities. In the Team Training exercise, they are supposed to act as a team without instructor intervention. There are objectives and a checklist for instructors to rate each team as satisfactory or unsatisfactory on performance objectives. This is not a "test" situation. Observation showed that instructors intervened as necessary and provided immediate feedback. There are team scores, not individual scores for members of the team. There was no

indication that team scores would be used to set recruits back or require them to repeat the exercise. In addition to Team Training, recruits also take part in a firefighting scenario as part of the all-night training exercise modeled on the Marine "crucible concept" training experience. Recruits do not receive group or individual scores in this exercise.

Instructional Interventions

Two instructional interventions are being developed. One uses a role model strategy and the other uses an advance organizer strategy. On order to design the interventions, research was conducted in the areas of cognitive science, learning theories, team competencies, communications, safety, teamwork, leadership skills, team process measures, and gender differences in personal skills development. The two interventions will be computer-based and use interactive multimedia presentations. A summary of the objectives and research efforts for each of the two interventions is described below, followed by a description of the two interventions.

Role Modeling Treatment

The *Role Modeling* treatment is being developed to help recruits develop appropriate attitudes regarding firefighting and the ability of females to perform in teams.

Objectives for the Role Modeling Treatment

Our research indicates that most recruits have not actually considered that firefighting would be part of their Navy experience. Furthermore, very few know what behaviors will lead to success in situations requiring teamwork, especially in highly stressful situations. In teams, such as the fire party, they are likely to rely on strategies they know and these may not be the most effective. As the research discussed below shows, this may be especially true for females. The Role Modeling treatment will incorporate human modeling techniques which are expected to influence the students to imitate the model's behavior, or more precisely, imitate the model's choice of actions. The learner will acquire an attitude which reflects the expressed or demonstrated activities of the human model.

Upon completion of the Role Modeling treatment, recruits will:

- Provide firefighting information to members of the team clearly, efficiently, and forcefully within Navy parameters.
- Use proper terminology and Navy standard communication procedures up and down the chain of command.
- Give orders with confidence, which is the product of knowledge and experience.
- State why they must learn to use protective breathing devices and firefighting equipment.
- Follow directions during firefighting exercises.
- Explain why they must refrain from inappropriate behavior, such as horseplay or unnecessary talking, during firefighting exercises.
- State why it is important to learn the safety hazards of firefighting equipment.
- Identify examples of monitoring others' performance and providing help when it is needed.
- Take and provide criticism and feedback objectively and constructively.
- Show situational awareness by identifying fire hazards.
- Show situational awareness by identifying egress routes.

To design the Role Modeling treatment, research was conducted in the areas of team competencies, communications, safety, teamwork, and leadership skills, team process measures, and gender differences in personal skills development. A summary of the research findings is presented below.

Research Supporting Design of the Role Modeling Treatment

Team Competencies

Teamwork was identified as one of the competencies to be taught in the Role Modeling treatment. Since the skills that make teamwork effective are not specifically addressed in RTC, it was necessary to establish the core skills that support effective team behaviors. Research indicates that in addition to having such team skills as adaptability, flexibility, and implicit coordination (Cannon-Bowers et al., 1993), teams have a variety of other competency requirements that can be cognitive, behavioral, or attitudinal in nature (Cannon-Bowers and Salas, in press). These team competencies, which are shown in Table 10, provided a framework for identifying with the Navy subject matter experts the specific knowledge, skills, and attitudes that will develop efficacy in recruits performing in teams in the context of firefighting training.

Table 10. Team Competencies

Knowledge	• Cue strategy associations • Task-specific teammate characteristics • Shared task models, knowledge of team mission, objectives and norms • Task sequencing • Accurate task models • Accurate problem models • Team role interaction patterns • Understanding of team work skills • Knowledge of boundary spanning role • Teammate characteristics
Skills	• Adaptability: flexibility, dynamic reallocation of function, and compensatory behavior • Shared situational awareness • Mutual performance monitoring, feedback and self-correction • Leadership and team management, including conflict resolution and assertiveness • Coordination - task integration • Communication • Decision making - problem solving
Attitudes	• Team orientation: willingness to be part of a team • Collective efficacy: the team's belief that it can cope with task demands • Shared vision • Team cohesion • Mutual trust • Task-specific team work attitudes • Collective orientation • Importance of team work

Communication, Safety, Teamwork, and Leadership Skills

The skills in the areas of communication, safety, teamwork, and leadership shown in Table 11 were identified during interviews with instructors, RDCs, Navy damage control specialists, and recruits at the RTC in Great Lakes, Illinois.

Table 11. Skills Identified at RTC

Communication Skills	• Speak loudly, forcefully, and assertively • Provide brief, precise directions and information • Use correct chain-of-command address procedures • Use correct terminology • Use hand signals correctly • Establish eye contact when possible • Use the sound-powered phone correctly • Recognize the meaning of ship's alarm signals
Safety Skills	• Wear proper garb • Use breathing device(s) correctly • Handle equipment correctly • Know the chain of command and follow directions • Refrain from any inappropriate behavior • Know the safety hazards for each piece of equipment • Perform all required actions to ensure watertight integrity of the ship • Generate an escape plan
Teamwork Skills	• Know the chain of command • Follow orders • Give orders when in charge • Monitor other team members' performance • Possess team spirit • Understand the entire team function and how one's particular tasks and responsibilities interrelate with those of other team members • Provide feedback to others objectively • Take criticism objectively
Leadership Skills	• Give orders with confidence • Listen carefully to superiors and subordinates • Take responsibility for errors and correct them immediately • Make decisions quickly, based on knowledge • Pay attention to detail • Know how to talk up and down the chain of command • Establish eye contact • Repeat back to ensure accurate communication • Acknowledge and perform in accordance with orders

Team Process Variables

Glickman et al. (1987) found that two separate tracks of behavior evolve during team training. The "taskwork" track involves skills that are related to the execution of the task and/or mission. In order to train for these tasks, shared mental models are especially useful. Taskwork is supported in the development of a shared mental model of teamwork, communication, leadership, and safety within the context of firefighting training, as well as in the overview of relevant information in the Advance Organizer. The Role Modeling treatment seeks to help recruits develop a shared mental model of teamwork, communication, leadership, and safety in the context of firefighting training. It is through this shared mental model that the Role Modeling treatment should affect role ambiguity and, therefore, reduce stress. (Cannon-Bowers and Salas, 1990). Teamwork involves skills that are related to functioning effectively as a team member, such as closed-loop communication, compensatory behavior, mutual performance monitoring, giving and receiving feedback, adaptability, and coordination (Mcintyre et al.,

1988). Teamwork knowledge, skills, and attitudes will be specifically addressed by the Role Modeling treatment. This relationship and distinction between teamwork and taskwork provides insights into the development of the treatments. Teamwork is specifically addressed in the Role Modeling treatment, which addressed the skills required to perform effectively as a team member.

A key factor in ensuring a team's success in a cognitively complex and stressful task environment is training that incorporates explanation, demonstration, practice, dialogue, and feedback (Bailey et al., 1995). Training should focus on team performance processes which are represented by communication flow, coordination behaviors, and team strategies (Bailey et al., 1995). The four team process measures (Johnston et al., 1995), shown in Table 12, provide valuable insight into the specific skills required for effective performance in teams.

Table 12. Team Process Measures

Situation Assessment	The ability to provide communication that promotes team awareness of the surrounding environment, both external and internal to the team.
Communication	The ability to exchange information clearly and efficiently using proper terminology, standard procedures for internal and external communications, and proper phraseology.
Compensatory Behavior	The ability to monitor the activities of other team members, take action to correct team errors, give and receive performance feedback in a non-defensive manner, and provide and seek assistance or backup when needed.
Team Leadership	The ability to provide needed guidance to other team members, helping team members focus their activities appropriately and anticipate tasks that should be performed, and to provide instruction to other team members to enable them to perform or complete their tasks.

Gender Differences in Personal Skills Development

Tannen (1994) describes many differences in male and female communication styles as well as in ways that women and men behave as part of teams and in leadership roles. While it is useful to recognize that there are gender differences which are disadvantageous to women, it is not the goal of the Role Modeling treatment to re-adjust the Navy to female styles. The goal is to help both females and males adjust their styles to the Navy standard communication skills. It is useful, however, to consider what many women and some men will have to overcome to achieve success.

In the following quote, Tannen identifies a basic difference between men and women in their ways of communicating.

> Conversational rituals among women are often ways of maintaining an appearance of equality, taking into account the effect of the exchange on the other person and expending effort to downplay the speaker's authority so they can get the job done without flexing their muscles in an obvious way. Conversational rituals among men often involve using opposition such as banter, joking, teasing, and playful put-downs, and expending effort to avoid the one-down position in the interaction.

This is important to the consideration of women's role in the Navy because females' conversational rituals will work in situations where others understand the meaning of the rituals. However, in many

situations, such as in the case of a firefighting team, the typical female conversation style may be ineffective. For example, in firefighting and many other military activities, there is a chain of command which, although it may be ad hoc, is expected to be followed. The nature of the task, and the need to perform in a dangerous, task-saturated environment, precludes team and leadership behaviors which may not come naturally to some women. Therefore, it is necessary for women to learn to modify their behavior in Navy team situations. Equally important, women must learn to accept other women performing in ways which are more frequently associated with males. When women use "male" conversational rituals they are perceived, especially by other women, as being domineering or abusive, while the same behavior from a male is considered strong, authoritative, and decisive. The following paragraphs describe areas where females may experience difficulty in learning to adapt to a hierarchical society in the areas of confidence, leadership, feedback and criticism, directness, and voice qualities.

Confidence. In a leadership position, recruits are expected to display confidence, which is judged by appearance and speech. According to Tannen (1994), women often appear less confident because they are more likely to downplay their certainty, while men are more likely to downplay their doubts. According to Tannen, when females make an effort to be less aggressive in their speech, they appear uncertain, even when they are not. The display of confidence was cited by the Navy subject matter experts as one of the effective skills involved in leadership. They did not say that women had more problems with the display of confidence, but this study supports the notion that it is likely that women would have more difficulty with this key aspect of leadership. The Role Modeling treatment will stress that neither men nor women should downplay their doubts, but when confidence is warranted, it should be freely expressed by both men and women.

Leadership. Leadership requires giving directions or orders to others. According to Tannen (1994), most females are acculturated against "bossiness" and have learned to suggest and give reasons. Giving short, precise orders, in a loud, forceful, confident, and assertive manner, has been identified as a necessary skill for leading firefighting teams. Tannen also provides valuable insight into the double bind in which women find themselves. If they are as aggressive or confident as men, they are seen as bossy or worse. If they behave in a way that is more "seemly," they are often considered to be ineffective and insecure.

Feedback and Criticism. Tannen (1994) discovered in her research that women often give tempered criticism and expect others to give them the same type of criticism. They often experience hurt feelings when untempered criticism is given. Many men prefer straightforward criticism and they operate on the conventionalized agreement that "this is business; feelings have no part in it." Not taking criticism "personally" has been identified as a necessary skill for performing in teams. Tannen provides a valuable insight into the way women give and accept criticism. Females are often accused of not saying what they mean when they are required to provide constructive criticism. Tannen very effectively makes it clear that it is the expectations of the listener that make the message unclear. The same concept of expectations is also at the root of females' perceived inability to take criticism when it is directly proffered. The researchers were told that females need to learn to "suck it up" when they are criticized. There are many reasons posited for females' inability to accept what they consider to be harsh criticism. They don't play in rough and tumble team sports, etc. Females in military situations are unlikely to get tempered criticism from males. It is important to help them understand this need, that it is not universal, and that they can learn to accept untempered criticism in work situations while maintaining their feeling of well-being. Females are also more likely to want and expect feedback, especially praise. They need to understand that for some males in leadership roles, failure to provide feedback indicates satisfaction and confidence in them.

Directness. Tannen (1994) discovered that one area in which males and females communicate differently is directness. Those who expect orders to be given politely or indirectly may be offended. At RTC, the ability to provide brief, precise directions was identified as a required communication skill. Females were

criticized for being garrulous in providing information or giving orders. Tannen's insights again can help women understand the differences and adapt to them. In adapting styles, it is necessary to consider the situation. There are some situations in which directness is absolutely necessary such as firefighting. While in other situations, indirectness can be tolerated. In any case, it is necessary to understand that indirectness may be misunderstood by some males, and directness may be unappreciated by some females.

Voice. Tannen (1994) discovered that females often exhibit "feminine" characteristics when they speak, such as speaking softly, not projecting their voices, or speaking in a high voice. But speaking loudly, forcefully and assertively were identified at RTC as required communication skills. Tannen's research can help females to understand that there are times when a modification to their preferred style is beneficial.

Women are often in a double bind, especially in their relationship to other women. Many women prefer to be led by men rather than women. They seem to resent directness, authoritativeness, and other displays of confidence and ability from other women. The Role Modeling treatment will model behavior by women which is appropriate to their tasks, but which may be different from stereotypical female behavior.

Design of Role Modeling Treatment

The content of the Role Modeling treatment will be realistic firefighting scenarios in which examples of appropriate and inappropriate behaviors are demonstrated in the areas of communication, safety, teamwork, and leadership skills. Multimedia presentations with voice-over narration will be used to point out specific examples of the knowledge, skills, and attitudes the recruit should develop during firefighting training.

The presentation will introduce male and female sailors who are recounting their experiences fighting fires on board ships. Each sailor will introduce and serve as the narrator of a short video sequence which shows examples of communication, safety, teamwork, or leadership skills. The voice-over narration will identify these skills as they are being performed.

On-line exercises will be provided in which the recruit will identify compliance and non-compliance with good leadership, communication, teamwork, and safety skills.

Additional exercises will be developed which will be used in the classroom after completion of the computer-based tutorial and exercises. In these off-line exercises, the recruits will role play in small groups of fellow recruits, with the instructor offering help and feedback. These exercises will not be graded. Instructors will receive instruction on conducting the role-playing exercises.

It is expected that recruits who receive the Role Modeling treatment will develop a sense of team efficacy and a sense of self-efficacy, which will prepare them for firefighting training. It should also help them develop task-generic teamwork skills, which will stand them in good stead throughout their careers.

It is estimated that it will take the average recruit 90 minutes to complete the Role Modeling treatment.

Advance Organizer Treatment

The *Advance Organizer* treatment is being developed to help the recruits learn firefighting tasks by relating the new learning to specifically relevant aspects of existing cognitive structure.

Objectives for the Advance Organizer Treatment

The goal of the Advance Organizer will be to bridge the gap between what the recruits already know and what they need to know in order to meaningfully learn to fight fires. The Advance Organizer treatment will provide a context of meaning for new information to be learned. It will help to orient the students toward the firefighting subject matter in such a way that the subject matter is directly related to any preexisting knowledge the students may already have. The Advance Organizer will help the students anticipate the performance requirements of the job by letting them know what to expect as well as to demonstrate the desired behaviors and attitudes for acceptable job performance.

The overall objective of the Advance Organizer is to provide recruits with a context of knowledge that will prepare them to succeed in the academic and hands-on components of firefighting training. Upon completion of the Advance Organizer treatment, the recruits will recognize that:

- Compartment ID and closures ID are necessary for reporting and responding to a fire.
- Understanding the characteristics and uses of portable and fixed fire extinguisher systems is necessary for firefighting effectively.
- Closing ship's closures is necessary to prevent spreading.
- All sailors must know the meaning of ship's alarms.
- Knowledge of the material conditions of readiness and the use of dewatering equipment is necessary to maintain watertight integrity.
- It is important to know the roles and responsibilities of fire party personnel.
- It is important to know how to don and use all breathing devices and protective clothing.
- It is necessary to know the types of fire extinguishing materials and systems that are used for the classes of fire and to know the hazards related to each.

Research Supporting Design of the Advance Organizer Treatment

To design the Advance Organizer treatment, research was conducted in the areas of cognitive learning styles and learner control. The research findings were used as a basis for deriving the instructional strategies on the premise that to overcome difficulties with the content of technical material, represented by the academic component of firefighting training, not only do females need analogies they can understand, they need an introduction to the information in a way that complements their unique learning styles. Computer-based training (CBT) is a dynamic medium, capable of varying such properties of a lesson as the content selected, modalities featured (sound, graphic, etc.), sequencing of topics, amount and level of practice, type of feedback, as the learners' needs dictate (Ross, 1984). The basis for program control may be as simple as evaluation of student performance in questions. However, it is possible to develop more complex and meaningful program control based on learner characteristics. Research was performed on learner characteristics, cognitive strategies, and the implications to instructional presentation.

Cognitive Learning Styles

In an effort to define cognitive style, Messick (1984) states that "cognitive learning style helps explain how an individual responds to a wide range of intellectual and perceptual stimuli." Cognitive style is not a single entity. Jonassen and Grabowski (1993) provide an understanding of the many dimensions that have been presented in the literature as comprising cognitive learning style. They identified twelve individual cognitive styles/controls: (1) reflectivity/impulsivity, (2) focal attention (scanning/focusing), (3) serialist/holistic, (4) field independence/field dependence, (5) flexibility (constricted/flexible), (6) category width (narrow/wide), (7) automization (strong/weak), (8) visual/haptic, (9) visualizer/verbalizer, (10) leveling/sharpening, (11) analytical/relational, and (12) complexity/simplicity.

Field Articulation

One area that is especially important to consider is field articulation. It is one of the few areas in which the research indicates significant male/female differences. In addition, field articulation has been studied extensively and is similar to analytic/global style, according to Ash (1986). In addressing the use of hypermedia presentation systems, Small and Grabowski (1992) discuss field articulation as a means of predicting how successfully learners will use hypermedia systems. Hypermedia is relevant here because there are many similarities between hypermedia and learner-controlled computer-based training (CBT). The literature provides insights into instructional strategies that can be employed which will make the learning experience more valuable for both field-independent and field-dependent learners. For example, field-independent individuals tend to discern figures as being discrete from their background, to focus on details, and to be more serialistic in their approach to learning. Field-dependent individuals typically see the global picture, ignore the details and approach a task more holistically. The implication for instruction is that field-independent individuals predictably would thrive on the details presented along the myriad paths available in hypermedia information systems while not necessarily gaining a global perspective of the topic at hand. Witkin et al. (1977) found that field-dependent subjects were at a disadvantage compared with field-independent subjects when required to complete a task requiring organization of material. High-spatial-ability recruits seem to have learner characteristics similar to field-independents (Shlechter, 1986).

Witkin and Goodenough (1981) characterized the information processing traits of the field-dependent style as passive. Because they have not developed sophisticated learning mediators, field-dependent individuals may use a chain-link information processing style. They also accept ideas as presented and do not modify them. They prefer teaching methods that encourage teacher-student interaction and like courses that emphasize social information. In contrast, Witkin and Goodenough saw the field-independent style as a complex and individualistic cognitive style. Its information processing traits, which include hypothesis-testing and restructuring skills, are examples of cognitive mediators that are used to reason about ambiguous and demanding problems. Their attitudes show that they prefer to learn independently and prefer courses that emphasize abstract and non-personal content.

Field dependence represents the tendency to perceive and adhere to an existing, externally imposed framework while field independence represents the tendency to restructure perceived information into a different framework (McGee, 1979). The field-dependence/field-independence construct is also associated with personality characteristics (Olstad et al., 1981) which have instructional ramifications. Field-dependents are likely to have a more social orientation than field-independents. Field-dependents tend to seek external referents for processing and structuring their information, are better at learning material with human content, are more readily influenced by the opinions of others, and are affected by the approval or disapproval of authority figures (Castenada et al., 1972). Field-independent individuals are more capable of developing their own internal referents and are more capable of restructuring their knowledge. They do not require an imposed external structure to process their experiences. Field-independents do not need external referents to process information and are better at learning impersonal, abstract material.

As characterized by Witkin (1950), field-independent learners are analytical, socially independent, inner-directed, individualistic, and possessed of a strong sense of self-identify. Field-dependent learners view things holistically and are extrinsically oriented, responsive to external reinforcement, aware of context, and cognizant of the effects that their learning has on others.

Witkin's (1981) field-dependence cognitive style theory predicts that females are more likely to have a social or field-dependent cognitive style, whereas males will more often have an analytical or field-

independent cognitive style. The results of a study by Hansen (1994) indicate a significant difference between groups of students based on ethnic origin (Asian, Hispanic, White). The results of the study confirm the findings of a number of researchers who found that ethnic minority students were more field dependent than white students (Castenada et al., 1972; Kagan and Zahn, 1975; Ramirez and Price-Williams, 1974). The implication is that instructional approaches must appeal to field-dependent individuals as well as field-independent individuals to ensure that instruction is not biased to favor individuals on the basis of gender or member of ethnic or racial groups.

Serialist/Holist

Pask (1976) identifies learning strategies as serialist vs. holist. Holists are characterized as learners who have many goals and working topics under their "aim" topic, assimilate information from many topics in order to learn the "aim" topic, entertain beliefs (often correct) about topics other than the working topics or the aim, tend to discover a global description of topics or to invent a description compatible with the conversational domain, ask questions about broad relations, form hypotheses about generalizations, and invent description schemes of their own. Serialists have one goal and working topic, which may be the aim topic; move on to another topic only when they are completely certain about the one they are currently studying; have no ideas about other topics; only describe the topic for which they are constructing an explanatory model; and ask much narrower questions.

He relates these two learning strategies to the more generally exhibited learning styles: operation learners and comprehension learners. According to Pask (1976), comprehension learners readily pick up an overall picture of the subject matter, are able to build descriptions of topics, and can describe the relation between topics. Their cognitive repertoire includes effective though individually distinctive description building operations, although such learners may not be able to apply these operations to specific subject matter information until the procedures underlying the concepts in question are specifically taught. Comprehension learners are prone, if left to their own resources, to act as holists.

Operation learners pick up rules, methods, and details, but are often unaware of how or why they fit together. They have at most a sparse mental picture of the material, and their recall of the way they originally learned is guided by arbitrary number schemes or accidental features of the presentation. If an operation learner is provided with a specific description, he assimilates procedures and builds concepts for isolated topics. The cognitive repertoire of operation learners includes accessible or effective procedure building operations and, if left to their own devices, they tend to act as serialists. Pask asserted that if the teaching strategy is matched to the same type of learning style, the recruit will learn more quickly and retain the information longer, while a mismatched condition leads to a pronounced failure to understand the principles underlying the subject matter. He cautions that a disposition to adapt a particular strategy does not necessarily indicate competence in using that strategy.

Rowland and Stuessey (1988) tested their theory that a holistic approach appeared to be the best way to learn from simulations while a serialist approach seemed the best way to learn from tutorials, and found that cognitive style does interact with the mode of computer-aided instruction (CAI) to influence student achievement. They discovered that individuals who are serialists will have difficulty learning from simulations. Further, they indicate that field independence, external locus of control, high discrimination skills, and low memory skills may contribute to poor performance on simulations (Rowland & Stuessey, 1988). They recommend that for serialists, use of a simulation should be preceded by a more structured learning activity. They also recommend that holists who use tutorials should be given an opportunity to see the "big picture" before they turn their attention to the details of a subject.

Spatial/Verbal

Shlechter (1986) reports that high-spatial-ability students seem to have learner characteristics similar to field-independent students. Field-dependent people rely on external sources, such as teachers, to structure and help them understand complex perceptual and abstract stimuli, while field-independent people do not need such external aids. Field-independent people are better able to use information inherent in such situations. Instructional situations with explicit instructions, concrete presentation of stimuli, and explicit information about performance outcomes favor field-dependent students. Field-independent students are better able to perform on more abstract and less structured tasks. One would expect that computer-based training (CBT) systems with structured instructional sequencing and continuous performance feedback would be the most appropriate for field-dependent people, while CBT programs with complex graphic and learner control features would be more geared toward field-independent people.

There are many dimensions to cognitive style. The goal of this analysis was to derive instructional strategies that would apply to learners with different instructional strategies. As these dimensions were analyzed, similarities and relationships began to emerge. It became evident that males and females were more likely to prefer the cognitive style of one category over the other. Two broad categories of cognitive traits were developed and their attributes were described. (See Table 13.) In addition, Kolb's (1976) preferred learning modes (See Table 14) were looked at for their relevance to gender and instructional strategies, and Rideout's (1989) discussion of the role of gender in decision-making strategies from Myers-Briggs Type Indicator (MBTI) (See Table 15) provided a basis for the instructional strategies for the Advance Organizer shown in Table 16.

Kolb's Learning Styles

Kolb's (1976) four learning styles are accommodator, diverger, converger, and assimilator. The learning characteristics of the styles are:

- Divergers excel in using imagination and brainstorming (doing and feeling).
- Convergers' dominant learning abilities are focused on finding practical uses for ideas and theories (doing and thinking).
- Assimilators are most adept at logically organizing and analyzing information, building and testing theories, and designing experiments (watching and thinking).
- Accommodators are best at learning from "hands-on" experience (doing and feeling).

Philbin et al. (1995) describe research that shows that while females are relatively well represented in each of the four learning styles, slightly more females are likely to be divergers or convergers. On the other hand, males are much more likely to be assimilators and relatively unlikely to be divergers. Brookfield (1986) suggests that characteristics of accommodators are somewhat analogous to those of field-dependent learners, in that, like accommodators, they prefer to use trial and error methods or some variant of active experimentation in their investigation of concrete experience and they rely heavily on others for information rather than on their own analytic ability. Philbin et al. completed a study which demonstrates a significant difference in learning style, using the Kolb indicator, between the genders. They concluded that traditional educational settings may not be the best learning environment for females. Traditional education is primarily abstract and reflective, which is a comfortable fit for Assimilators. The learning style that seems to fit women the least is the assimilator. Females learn better in hands-on and practical settings, emphasizing the realm of the affective and "doing." Based on Philbin's study, females learn best when they are watching and feeling, or doing and thinking. On the other hand, males learn best when they are thinking and watching. The gender representation and preferred learning mode of each of Kolb's four learning styles are shown in Table 14 (Philbin et al., 1995).

Table 13. Attributes of Learners

Field-Dependent/Verbal Holist/Global/Comprehension	Field-Independent/Spatial/ Linear/Serialist/Operation
Field-dependent individuals typically see the global picture, ignore the details and approach a task more holistically.	Field-independent individuals tend to focus on details and to be more serialistic in their approach to learning.
Field-dependents may use a chain-link information processing style. They also accept ideas as presented and do not modify them.	Field-independents' information-processing traits include hypothesis-testing and restructuring skills.
Field-dependents prefer teaching methods that encourage teacher-student interaction and like courses that emphasize social information.	Field-independents prefer to learn independently and prefer courses that emphasize abstract and non-personal content.
Field dependence represents the tendency to perceive and adhere to an existing, externally imposed framework.	Field independence represents the tendency to restructure perceived information into a different framework.
Field-dependents are likely to have a more social orientation. They tend to seek external referents for processing and structuring their information.	Field-independent individuals are more capable of developing their own internal referents and are more capable of restructuring their knowledge. They do not require an imposed external structure to process their experiences.
Field-dependents are better at learning material with human content.	Field-independents do not need external referents to process information and are better at learning impersonal, abstract material.
Field dependence represents the tendency to perceive and adhere to an existing, externally imposed framework.	Field independence represents a tendency to restructure perceived information into a different framework.
Field-dependents typically see the global picture, ignore the details, and approach a task more holistically. Therefore, they should be less frustrated by extracting global information from the material presented.	Field-independents predictably would thrive on details presented along the myriad paths available in hypermedia presentations.
Field-dependent learners view things holistically and are cognizant of the effects that their learning has on others.	Field-independent learners are analytical, socially independent, inner-directed, individualistic, and possessed of a strong sense of self-identity.
The holist strategy uses a global approach. Learners first build broad descriptions, then fit in details. Holists learn best from simulations.	The serialist strategy uses a local approach, where the learner concentrates on narrow procedures before the overall picture emerges. Serialists learn best from tutorials.
Holists who use tutorials should be given an opportunity to see the "big picture' before they turn their attention to the details of a subject.	Serialists will have difficulty learning from simulations. If simulations are used for serialists they should be preceded by more structured learning activities.
Comprehension learners readily pick up an overall picture of the subject matter. They are able to build descriptions of topics and describe the relation between topics.	Operation learners pick up rules, methods, and details, but are often unaware of how or why they fit together.
Low spatial individuals are more like field-dependent learners.	Individuals with high spatial ability seem to have learner characteristics similar to field-independent individuals.
Field-dependent people rely on external sources to structure and help them understand complex perceptual and abstract stimuli.	Field-dependent people are better able to able to use information in complex and abstract stimuli.
Instructional situations with explicit instructions, concrete presentations of stimuli and explicit information about performance outcomes favor field-dependent students.	Field-independent students are better able to perform on more abstract and less structured tasks.

Table 14. Kolb's Learning Style Model

Learning Style	Percentage Of Females	Percentage Of Males	Preferred Learning Mode
Accommodator	22.0	20.0	Best at learning from "hands-on" experience (doing and feeling)
Diverger	28.9	8.0	Excel in using imagination and brainstorming, combining concrete experience and reflective observation (watching and feeling)
Converger	28.9	24.0	Dominant learning abilities are focused on finding practical uses for ideas and theories (doing and thinking)
Assimilator	20.0	48.0	Most adept at logically organizing and analyzing information and building and testing theories (watching and thinking)

Myers-Briggs Decision-Making Strategies

Rideout (1989) states that the thinking and feeling functions are the only dimensions of the Myers-Briggs Type Indicator (MBTI) in which there is a trend in gender differences. The thinking-feeling dichotomy forms the basis upon which people make decisions or judgments. Women are more likely to base decisions on feelings, whereas men are more likely to base decisions on thinking. The implication for this dichotomy is that females are motivated by appealing to their personal and subjective values, while males are motivated on the basis of abstract principles. Table 15 shows the preferred basis for decision-making by gender.

Table 15. Peferred Decision-Making Strategies

Preferred Strategy	Percentage Of Females	Percentage Of Males	Basis For Making Decisions
Thinking	35.0	60.0	Make decisions on the basis of logic or abstract principles—"the analytic factor." Contribute to society through intellectual criticism.
Feeling	65.0	40.0	Make decisions on the basis of personal and subjective values—"the bonding factor." Contribute to society through support of good works.

Implications of the Research to the Design of the Advance Organizer

The research conducted for the design of the Advance Organizer supports the development of two broad categories of learning styles for the purposes of tailoring instructional strategies to make the instruction more meaningful to individuals. Field-dependent individuals share many cognitive similarities with verbal learners. Field-independent individuals share many cognitive similarities with spatial learners. We know that women are more likely to be field-dependent, while men are more likely to be field-independent. Research shows that field-dependent learners prefer strategies that focus on the explicit and

concrete where information is presented from the specific to the general. Field-independent learners prefer strategies that focus on the abstract and unstructured where information is presented from the general to the specific.

Using the Kolb model, women are slightly more likely to be divergers and convergers, which indicates that they prefer combining concrete experience and reflective observation and finding practical uses for ideas and theories. Research also shows that men are much more likely to be assimilators, indicating that they are most adept at organizing and analyzing abstract information. Using the Myers-Briggs indicator, men have been found to prefer thinking as the basis for decision-making while women prefer feeling as the basis of decision-making. This indicates that information given to women should stress how it contributes to the good of all, while information presented to men should stress logic or abstract principles. The paragraphs below describe the instructional strategies that will be used for each of the two broad categories.

One of the goals for the design of the Advance Organizer is to present a conceptual framework for the new knowledge and skills presented in firefighting training in ways that will appeal to both "female" and "male" learning styles. During the literature review, instructional strategies that are expected to be effective for different learning styles were identified. These were applied to each of the two broad categories of learners as prescriptions for strategies that would present the material most effectively for each type of learner. This is not to say that we expect a learner to use one cognitive strategy in all situations. We strongly suspect that learners switch strategies to accommodate different subject areas and different circumstances. Therefore, the Advance Organizer will provide different instructional modes to accommodate different cognitive strategies and will record which strategies are being used at particular points in the instruction, and will assess whether they are switching strategies.

The findings from the research described above were combined in order to develop the instructional strategies for the Advance Organizer. The strategies are shown in Table 16.

Content of the Advance Organizer Treatment

The Advance Organizer will provide a conceptual framework for learning the following topics in the firefighting course:

1. Ship's watertight compartments and compartment ID system
2. Shipboard closures
3. Material conditions of readiness
4. Breathing devices
5. Protective clothing
6. Extinguishing agents
7. Classes of fire
8. Portable and fixed fire extinguishers
9. Firefighting party procedures and personnel

Table 16. Instructional Strategies for the Advance Organizer

Field-Dependent/Verbal/ Holistic/ Comprehension Learners	Field-Independent/ Spatial/ Linear (Serialist)/ Operation Learners
Provide structured instructional sequencing.	Provide learner control features.
Provide continuous performance feedback.	Provide necessary feedback.
Provide a verbal overview.	Provide a graphic overview with complex graphics.
Structure information to be presented.	Allow students to derive the structure of the information.
Associate ideas with their practical application.	Show (graphically) why the material is important.
Provide explicit information about performance outcomes.	Allow students to inquire about performance outcomes.
Explain how the various components fit together, then provide a global perspective.	Show the performance (global perspective) and let students identify the components.
Provide a verbal organizer.	Provide a graphic organizer.
Explain why damage control is important and how each individual contributes to the welfare of all.	Explain why it is necessary to acquire all the knowledge and skills to perform effectively.
Provide a verbal description of the "big picture."	Use a graphic presentation to show the "big picture" and let students derive the specifics.
Provide "context" for the roles the learner will perform as part of the team and what they will need to know to fulfill their responsibilities.	Provide "context" in terms of what they will learn and how they will use the knowledge to perform their roles in the firefighting team.
Use an expository presentation: Present a generality and demonstrate the necessary skills to understand the higher-level skill.	Use a discovery presentation: Allow the learner to discover the higher-level skill.
Emphasize that during training, "hands-on" experiences will be provided.	Emphasize that during training, learners will use knowledge gained in academic training.
Provide information from the specific to the general.	Provide information from the general to the specific.
Provide simulations rather than tutorials. If tutorials are used, provide an opportunity to see the "big picture" before turning their attention to the details of a subject.	Provide tutorials rather than simulations. If simulations are used, they should be preceded by more structured learning activities; or actual use of the simulation should be more structured.
During demonstrations, emphasize "feeling" aspects of activities: working toward the common good.	During demonstrations, emphasize "thinking" aspects of activities: developing expertise.

Design of the Advance Organizer Treatment

The Advance Organizer uses a combination of learner control and intelligent tutoring with assessment of student requirements and presentation of appropriate material to provide a unique instructional experience to each student. The system will present information in ways that will specifically address the style and/or concerns of the learner.

Learner Control

The system begins by asking the student to select one of the following: "I want to learn all about firefighting training" (tutorial), "I want some information on firefighting training" (access to specific

modules via a lesson map), or "I want to test my knowledge" (test). This choice is essentially between three expository approaches, a structured instructional approach (tutorial), an approach in which the learner imposes his or her own structure (lesson map), or a test. With the choice of expository approach, the learner will indicate something about his or her preferred cognitive style. It is expected that a field dependent/verbal/linear/operation learner will select the tutorial, while a field-independent/spatial/ holistic/comprehension learner will select the lesson map. Selection of the test indicates that either the learner already knows the information or that he or she wants to determine what is already known and get an indication of what must be learned. An individual who immediately elects to take the test is likely to be field-independent.

Selection of the Tutorial. If the student selects the tutorial, this indicates his or her preference for structured instructional sequencing and a verbal overview of the topic. Since the student has indicated that he or she is a field-dependent learner, the system will structure the lesson for the student. The audio narration of the tutorial will further support the field-dependent learner by associating ideas with their practical application, providing explicit information about performance outcomes, and structuring information from the specific to the general.

Selection of the Lesson Map. If the student selects the lesson map, this indicates his or her preference to have control over the sequencing of information, thus exhibiting characteristics of a field-independent learner. Since the student has indicated that he or she is a field-independent learner, the system will provide a graphic overview of firefighting in the form of a multimedia course map. Once the introduction is over, the student will be able to select specific topics. In doing so, the student will be deriving his or her own structure of the information and exercising learner control over the structure and sequencing of the information. The course map structure fits the field-independent learning style by providing a "big picture" of the lesson material before the student's attention turns to the details of the subject.

Selection of the Test. If the student selects the test, this indicates his or her preference for a discovery presentation. By participating immediately in the test, the student will discover what he or she does and does not already know. Once this is determined the student can access only those parts of the information needed. This student is exhibiting characteristics of a field-independent/holistic learner.

Learner Questions

In either the tutorial or lesson map expository approach, questions will appear on any screen that is presenting information. Prompted by these questions, the learner will be able to ask questions which will vary according to the instructional content being presented. The learner can stop the presentation at any time by asking a question.

The question will be answered and the presentation will continue. The answer is specific to the information being presented. For example, during the presentation on Compartment Identification if the learner asks, "Why is it important to know this?", the system will respond by explaining the importance of boat geography—that for safety reasons you must always know exactly where you are in case of emergencies.

In addition to answering the question, the system will also know whether the question indicates that the learner is exhibiting a particular cognitive style or that the learner has a particular concern about the material being presented. The system knows this by the type of question the student is asking. For example, if the learner asks the system, "Why is it important for me to do that?", she will be indicating a particular cognitive style, namely that she is a field-dependent learner with a concern for the "feeling" aspects of activities and how they relate to the common good. When the system determines that the

learner is exhibiting a particular cognitive style, the system will present the learner with instructional content in a way that is consistent with that cognitive style.

On the other hand, if the learner asks the system, "Do women serve on damage control teams?", the learner will be indicating a concern with women's role in firefighting. When the system determines that the learner has a particular concern, it will present additional information wherever appropriate to address that concern.

Throughout the instruction the learner will retain control of the pace and presentation. The learner can switch from the tutorial, lesson map, or test at any time. It is estimated that it will take the average recruit 90 minutes to complete the Advance Organizer treatment.

Research on Learner Control

Providing control of pace, sequence, content, and other elements to the learner individualizes instruction (Daniels, 1996). Accommodating the learner, as opposed to the learner having to accommodate the instruction, has been shown to result in higher achievement and improved attitudes (Frey and Simonson, 1994). Research has also shown that learner control promotes retention of information because decisions students make while progressing through instruction typically require deeper processing and reflection on the learning process. This decision-making process promotes elaboration, and allows learners to adjust the rate of encoding and processing to their individual level (Merrill, 1984; Williams, 1993). Reigeluth and Stein (1983) advocate "informed learner control." The term "informed" implies both cognitive (processes) and metacognitive (knowledge of those processes) skills.

Other findings from the research indicate that students with high ability and those with high levels of prior knowledge appear to benefit more from learner control strategies than other types of students (Williams, 1993). Subject matter also appears to influence the effectiveness of learner control treatments (Daniels, 1996). Social-oriented subjects which have less specific rules and procedures (e.g., learning communication skills) usually showed more positive results under learner control. Domains that are more rule-driven and require precise application of declarative knowledge (e.g., learning math) consistently resulted in less achievement for learner control treatments (Packard, 1996; Steinberg, 1989; Williams, 1993).

Learner control is assumed to be a beneficial feature of computer-based training (CBT) (Jonassen, 1988; Marchionini, 1988; Moore et al., in press; Park, 1991). However, it should be noted that interactive computer-based programs have the potential of creating cognitive and metacognitive problems if care is not taken during the design phase (Daniels, 1996). A commonly reported negative effect is that student can "get lost" and experience "cognitive overload" as they navigate through CBT (Chung and Reigeluth, 1992; Jonassen, 1988; Jonassen, 1991; Marchionini, 1988; Park, 1991). Sometimes when learners are faced with navigation decisions in a complex CBT program, the cognitive demand will consume mental resources that should be available for learning (Gray, 1987; Park, 1991; Tripp and Roby, 1990). Hypermedia links that are either tangential or irrelevant cause more confusion (Nelson and Palumbo, 1992). In addition, many CBT programs do not provide navigation trails or exit paths when they are needed (Cates, 1992).

Several studies of CBT instruction have noted the absence of metacognitive ability in learners to monitor and assess their learning and take proper action to remedy their deficiencies (Jonassen, 1991; Lin, 1994; Weller et al., 1994). It is suggested that the lack of ability to assess their state of learning and take action to remedy their deficiencies leads to students missing important information, frustration, and incorrect conceptual links (Clark, 1983; Merrill, 1984; Park, 1991; Recker and Pirolli, 1992). As a result,

researchers have recently begun to investigate not only the functional features of hypermedia but how these features interact with individual learners' characteristics (Daniels, 1996).

Research Design

Developments during the first year of the project have affected the research design in several ways. It has been necessary to change the overall design structure to bring it in line with the current organization of firefighting training at the Recruit Training Command. The frequency of stress measurements will be reduced as a result of limitations on the computer resources available to the project. Proposed measures of stress have been developed, then abbreviated to fit the modified research design. The assessment of performance has been extended to include hands-on firefighting tests developed by the Recruit Training Command. The rationale for each of these modifications is summarized in this discussion. Appendix B provides greater detail.

Experimental Design

The original experimental design called for a 2 x 2 x 3 Advance Organizer x Role Model x Hierarchical Level research design. The Advance Organizer and Role Model elements of the design represented the experimental instructional treatments to be developed in the study. The two levels of the design for each instructional treatment were Not Exposed or Exposed to that treatment. The Hierarchical Level factor was based on the fact that people occupy different levels in the organizational hierarchy in shipboard firefighting. This initial design was to be implemented with only female recruits as the subjects of study.

The revised research design is a 2 x 2 x 2 Advance Organizer x Role Model x Sex research design. The hierarchical level element of the original design was dropped because it is part of shipboard firefighting structure, but not part of the structure of basic training. Sex was added to the design because female recruit divisions now are paired with male recruit divisions. Paired divisions follow the same training schedule. Any attempt to separate the male and female recruits would require major changes in the standard training schedule. The effort required for this separation would substantially increase the problems the study poses for the training staff at the Recruit Training Command. Also, Recruit Training Command policy requires that any potentially beneficial instructional aids or other techniques or procedures that might improve performance be made available to both male and female recruits. Including both sexes in the study will permit an evaluation of the likely impact of the new training tools on the overall recruit population. This impact must be known to evaluate the expected payoff from implementing the new tools as part of training once the study is completed.

A further alternative to the original design has been developed to prepare for possible scheduling problems. The alternative is a 3 x 2 Treatment x Sex research design. This design has been considered to anticipate the problems that could arise if there is too little time in the training schedule to administer both treatments to a subset of the recruits in the study. Basic training is designed to cover the wide range of topics needed to transform recruits from civilians to sailors. The objective is to accomplish this transformation with the greatest efficiency possible. The result is a very tight training schedule with little free time. In this context, the Advance Organizer and Role Modeling treatments each will require a significant block of time to administer. The original research design called for some recruits to receive both treatments, while other recruits received only one treatment, and some recruits receive no treatments.

Given the tight training schedule, it may be impossible for any recruits to receive both treatments. If so, the alternative 2 x 3 Gender x Treatment design will be used. In this case, the experimental groups would consist of Advance Organizer (only), Role Modeling (only), and No Treatment (control) groups. Shifting to this design would mean the loss of the opportunity to determine whether the different

treatments had additive or interactive effects. This information could be important for applied decisions regarding whether to implement one treatment or both to obtain the best training outcomes. However, the revised design will provide a basis for stating whether either or both of the treatments improves training performance. The issue of combined effectiveness then may be a follow-on topic that can be investigated quickly and inexpensively if the Recruit Training Command wishes to do so.

Stress Measurement

Stress Content Issues

A questionnaire to assess the intervention effects on stress indicators has been developed and revised, but not yet validated in the study population. The initial plan called for the questionnaire to be developed from earlier inventories, then administered to U.S. Navy recruits for assessment. A 33-item stress questionnaire was developed for this purpose. This instrument was to be combined with Profile of Mood States (POMS) to provide a complete assessment of stress effects. The POMS consists of a set of 65 mood descriptors; respondents indicate how each descriptor applies or applied to them during a stated time period.

However, a 98-item questionnaire takes a long time to administer to recruits. Past experience suggests that this would involve a period of at least 25 minutes if the questions were read to recruits. An estimated additional 10 minutes would be needed if the recruits read the questions for themselves. Familiarity with the time constraints in the training environment suggested that it would be difficult to find time to administer the initial questionnaire to recruits.

For this reason, an abbreviated version of the initial questionnaire was constructed. That questionnaire is presented in Appendix B-2. This abbreviation was made after review of the major study hypotheses indicated that they could be answered satisfactorily with shorter measures. The revised questionnaire consists of 28 stress questions and 12 mood questions. The 28 stress questions assess the three major stresses of interest for the project. The 28 stress questions include 15 items from previous scales. Two other items were formed by splitting what had been a compound item into two separate elements. Four new stress items were based on information from recruits interviewed about firefighting training. Seven items are designed to measure self-efficacy in relation to firefighting. As described in Appendix B, this set of items was established by exploratory and confirmatory factor analysis of data from a larger set of 26 questions. The data were obtained from U.S. Marine Corps recruits who undergo qualitatively similar experiences in basic training to those encountered by U.S. Navy recruits. The 26 questions originally were designed to measure role ambiguity, role conflict, overload, standardization, and teamwork. Standardization and teamwork were added to the item analysis because they were logical antecedents of the target stresses of interest in this project.

Analysis resulted in a set of modified scales. The analysis indicated that teamwork items were of no value for measuring role conflict, role ambiguity, or overload. However, standardization items were useful. At least one item originally believed to be an indicator of standardization proved to be a viable component for each of the ambiguity, conflict, and overload scales.

The self-efficacy and perceived stress items in the Prototype Stress Assessment Profile may be modified based on results of administration of the Initial Firefighting Stress Questionnaire in November, 1997. This questionnaire consists of 34 items and includes measures of role clarity, role conflict, teamwork, standardization, overload, efficacy, and additional items. The Initial Firefighting Stress Questionnaire is provided in Appendix B-1.

Mood Assessment Issues

Mood assessment shifted from measuring the specific moods using scales from the Profile of Mood States (POMS) to measuring two general dimensions of affect. Measures of depression, anxiety, vigor, and other specific moods were replaced by scales assessing positive and negative mood.

The modified approach to mood assessment was adopted because scales designed to assess specific moods typically are moderately to highly correlated. For example, correlations between measures of depression and anxiety typically are on the order of $\underline{r} = .70$. Highly correlated measures are redundant, and time constraints made redundancy a luxury that could not be afforded in this study. Relatively little information is likely to be gained by assessing specific moods in detail instead of assessing two well-established higher order mood dimensions. Furthermore, the study hypotheses do not predict treatment effects that would be evident as changes in a particular type of mood. Instead, the general hypothesis is that lowering stress will decrease negative mood and may increase positive mood or both.

The modified approach to mood assessment reduced the total number of mood items from 65 to 12. Analysis of responses to these items in previous studies of U.S. Navy recruits indicates that these brief scales should have adequate measurement precision for the study purposes.

Timing of Stress Measures

The original research plan called for repeated measures of stress indicators, including mood scales. Measurements were to be obtained near the beginning of firefighting training, after exposure to the experimental treatment but before hands-on firefighting, and after hands-on firefighting. The original plan assumed that recruits would be in the computer laboratory often enough to permit these measures to be administered and recorded by computer. However, given the structured nature of recruit training, this seems unlikely.

Paper-and-pencil data collection is the alternative to computer data collection. Given the time required to administer a questionnaire, repeated measurements become a logistic problem for this mode of administration. Repeated interruptions in a tight training schedule could severely compromise cooperation with the project. In addition, paper-and-pencil administration involves much more personnel time not only to administer the questionnaires, but to enter the data into data bases, check the data, and otherwise prepare for data analysis.

The personnel-intensive nature of the paper-and-pencil tests and the time required to administer them have shifted the testing procedure to a post-test only assessment. This approach will be somewhat less sensitive to treatment differences than would have been the case with repeated measures. Any stable individual differences in stress will remain part of the error term in the analyses, rather than being removed as a between-persons score component. However, power analyses suggest that post-test only designs should be adequately sensitive to substantial differences between the groups. Analyses of other variables such as intelligence test scores, age, education, and other demographic attributes will be added to the study to determine whether the experimental groups were composed of comparable recruits. If so, it will be reasonable to assume that the stress levels and affect were comparable prior to exposure to the treatments. This additional evaluation also will increase the personnel resource requirements of the recruit training component of the study.

Current Status of Stress Measures

The final step in developing the stress assessment tools will be a confirmatory factor analysis of data from U.S. Navy recruits. Permission to administer the Initial Firefighting Stress Questionnaire to U.S.

Navy personnel has been given by the responsible Chief of Naval Operations code. The data collection is scheduled for early November and should be completed by the end of December. Experience indicates that measurement models generalize well from one recruit training setting to another, so it is expected that the analysis will show the measures to be appropriate for U.S. Navy recruits.

Performance Assessment

Performance measures will be obtained from standardized tests given in basic training. These scores include results of academic tests and new hands-on performance tests which have team scores. The original plan to include performance measures from post-basic training Fleet firefighting school will have to be dropped from the study for reasons explained below.

Academic Tests

Test scores for the Test 4 (firefighting) were obtained for FY 97. The percentage of all recruits who fail Test 4 the first time is 3.4 percent for females and 2 percent for males. The percentage of recruits who failed the test the second time, and thus were set back, is 0.59 percent for females and 0.23 percent for males. Work by other researchers has shown that firefighting academic scores are related to Armed Forces Qualifying Test (AFQT) scores (Slater, 1997).

The academic tests for firefighting have been modified recently. Past evidence, therefore, provides a qualitative picture of the differences between female and male recruit divisions that should generalize to the new test. The generalizable qualities of the test are that AFQT scores still should be a useful covariate, and women may continue to do slightly less well than men on the tests. The strength of the AFQT-performance association and the magnitude of sex differences in performance cannot be quantified at this time.

Hands-on Performance Measures

The Recruit Training Command has developed additional performance measures during the past year. The hands-on component of firefighting training is now graded on a pass-fail basis. The performance measures specify in a step-by-step fashion the actions required to fight the fires that recruits encounter in this controlled training environment. The success of the team is determined by whether or not the required actions are performed in the proper sequence. The pass-fail decision applies to firefighting teams, not to individuals.

The hands-on performance measures can be analyzed with teams as the unit of observation. Whether a team passes or fails the performance test can be recorded. The proportion of teams passing the test then can be determined for divisions that received the Advance Organizer, Role Modeling, both, or neither. The proportions then can be compared using standard procedures such as the χ^2 test or tests for differences in proportions comparing the treatment groups to the control group.

The new procedures have been in use only a short period of time, so there is too little information available to determine base rates of success and to work out the number of teams that would have to be studied to permit meaningful inferences about the hands-on performance effects of the training interventions. These elements of the study will have to be worked out during the implementation of the study design.

Fleet Firefighting Training

The original research plan called for a follow-up of trainees who received the experimental treatments. The objective was to determine whether the interventions affected learning and performance closer to the job site. In particular, the intent was to measure performance at Fleet firefighting training to determine whether the treatments affected the individual's readiness to master more advanced firefighting skills.

This element of the project cannot be implemented for several reasons. Firefighting school adopts a different approach to learning and evaluation. In this school, the students are instructed, then asked to fight controlled fires. Evaluation takes the form of correction when mistakes are made during the procedures and debriefing to discuss how things could have gone differently. The academic tests that are given are not recorded. The firefighting itself is done as a member of a team. For these reasons, there are no firefighting scores available for individuals.

Consideration was given to developing team scoring methods. This approach is impractical because teams would include mixtures of some people who received one treatment, some who received another, and some who received both (if that option can be implemented). In addition, most or all teams would include some people who went through basic training prior to the introduction of the interventions. Thus, it would be very unlikely that any one team would consist solely of people who received the Advanced Organizer, for example. Collecting a large number of homogenous teams would be an extremely difficult task. Furthermore, the likelihood of an all-female team would be extremely small. The preceding considerations lead to the conclusion that follow-up assessment at Fleet Firefighting is not a reasonable undertaking.

Obtaining Recruit Training Command Measures

The Recruit Training Command has significantly increased computer support for tracking and monitoring training progress in the past several years. The current system records abilities and academic test performance. These scores are readily available provided appropriate steps can be taken to obtain access to them.

The key issue is whether individual identifiers will be needed to pair the data from the academic files with those from other sources. Analyses of the general effects of interventions can proceed without the individual identifiers. Recruit divisions are likely to be the unit of sampling for treatment administration. Thus, the data can be extracted for all individuals within a division without asking for individual identifiers. If roughly the same proportion of recruits from each Division attend the intervention sessions, this approach will provide treatment estimates that are roughly comparable for comparisons between interventions. The comparisons will be biased downward slightly when comparing treatment and control groups because some in the treatment group will effectively be controls (i.e., will have missed the session and, therefore, not be exposed to the treatment). The exact magnitude of this problem will be studied in more detail as the treatments are implemented.

Individual identifier data will be needed whenever stress assessments must be matched to performance. In this case, the key issue will be to ensure that informed consent is given by the participants prior to collecting the stress assessment data. That informed consent must grant permission to obtain the necessary information from training records. With this permission, there should be no problem obtaining the data.

Psychometric Evaluation of the Recruit Training Measures

A technical psychometric evaluation of the academic performance data is not appropriate. Such evaluations typically focus on considerations of measurement precision (i.e., reliability), factor structure, and other similar criteria. These criteria are relevant to the measurement of psychological constructs which involve a single dimension of individual differences (e.g., depression, stress). In these cases, it is reasonable to assume that response differences between individuals reflect differences in the strength or quality of the underlying psychological processes that give rise to the behaviors and feelings referred to in the items. The items are chosen to reflect those underlying processes, so some degree of coherence (i.e., correlation) among the indicator variables is expected. The absence of that coherence is reason to question the validity of the scale.

Academic achievement measures do not fit the standard psychometric model, except in special cases. Suppose, for example, that a course involved learning several different principles and their applications. The probability of getting the correct answer to two different questions then will depend on whether the questions draw on the same principle. If different people master different principles, there may be little correlation between questions involving different principles. On the whole, the correlation between getting one question right and getting another question right may be quite small because different principles were involved in many item pairs. For this reason, standard psychometric models are of limited value in evaluating academic tests. In short, the validity of an academic test does not rest on internal consistency of the measure.

Content validity is the major concern for an academic test. Does the test accurately reflect mastery of the material that is being taught? If so, the test is valid in the most important sense given the purpose for which it was constructed. The content validity of the acadmic tests has been reviewed extensively by U.S. Navy educational experts within the past two years to ensure that it maps onto current course content. The nature and content of questions and the instructional content of the firefighting course have been reviewed to ensure that the training meets the objective of preparing recruits to fight fires in the fleet. This review was conducted by U.S. Navy subject matter experts who have endorsed the existing test as an accurate representation of the academic content of the firefighting course. Based on this review, the academic tests are valid indicators of mastery of the knowledge required for firefighting.

RECOMMENDATIONS IN RELATION TO SOW

We recommend that the Statement of Work (SOW) continue to be implemented as proposed. There are no anticipated changes to the SOW. However, the following are changes to the research design. An explanation of each change and the reasons for the changes is provided in the discussion above.

- Replacement of gender for hierarchy in the research design
- Change in the number of stress measures from three to one post-test measure
- Deletion of the plan to include performance measures from Fleet firefighting school
- Change from computerized to paper-based stress measures

CONCLUSIONS

As this is the first year of the project, no definitive conclusions can be derived from the application of the yet-to-be-completed development of interventions. However, all of the objectives for the first year were met: analysis of the training requirements; development of measures to assess stress, efficacy, and performance; development of the Treatment Plan; and design of the multimedia interventions.

The recruit demographics, attrition analysis and literature review strongly support the assumptions that were made at the inception of the project. Females are a minority in the Navy population. In Recruit Training, they comprise 13.6 percent of that population. In the Navy force structure, they account for 15 percent. Navy historically has been a Service with strong male-dominated traditions. Its current efforts to fully integrate the females must also include interventions which allow not only females but male sailors to recognize and accommodate leadership, personal, and communication strategy differences. This research should provide greater insight into those differences. Better understanding allows for an improved ability to address these differences with sound, theoretically valid pedagogical interventions.

The literature review, particularly the studies by Tannen (1994, 1990) and Gray (1992) supported the Navy experience in training. These authors gave names to issues that had been intuitive to Navy instructors—females seem to be more emotional, leaderships styles were different, communication strategies did not match a male-dominated Navy lexicon. Recognition of those differences is the first step in improvement of instructional methodologies and content. A corollary that warrants further investigation and will be addressed in the project is, "Are there gender differences in cognitive learning styles?" Attrition data seem to support that concept. Females are experiencing a significant amount of stress in the recruit training environment. For reasons such as personality disorders, psychiatric factors, and adjustment disorders, females attrite at almost double the rate of males. There are several factors which account for this phenomenon. Leaders treat females differently and are more likely to provide psychological help to women than men. Women tend to be more open and to discuss their emotions more than men. Finally (the focus of this project), women are experiencing more stress in the male-dominated training environment. The project includes the identification and development of stress assessment tools to measure the impact of the project interventions on the female recruits.

Significance to the Navy

If the assumptions bear out and the interventions are successful, the benefit to the Navy will be significant. Training environment and instructional methodologies will become more effective and efficient. Such results have the potential to reduce training length and decrease attrition. Both of these outcomes will save training dollars. In the current ambiance of fiscal frugality, the impact is sorely needed. Boot camp will also be able to provide the fleet with a better sailor—one who will perform in the job more ably, be highly motivated, and fully embrace the Navy's core values. All of these results lead to improved fleet readiness.

Significance to Other Organizations

Data from this study will provide a basis on which to re-engineer the current pedagogical paradigms. Instead of ignoring gender differences, a better understanding can result in more effective interventions being developed. The technology of the Advance Organizer can prove useful in assessing the best methodology to use to instruct a curriculum. The stress data will contribute to the growing literature on its effect in occupational research and contribute positively to developing better job classification vehicles.

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APPENDIX A

TRAINING REQUIREMENTS

TRAINING REQUIREMENTS

Introduction

The following instructional analysis techniques were used to identify the training requirements: training intervention analysis, observation, and data review. The purpose, description, and outcome of each analysis technique are presented in the paragraphs below. This is followed by the objectives and content derived for both of the multimedia interventions.

Training Intervention Analysis

The training intervention analysis consisted of interviews with key personnel from the Naval Training Center, including instructors, recruit division commanders (RDCs), and test personnel. The purpose of these interviews was to determine the mission, problems, staff requirements, target audience, and training needs related to females in firefighting training. Students were also interviewed to gain insight into their specific concerns. Interview worksheets were developed prior to conducting interviews. Interviews were used to identify elements of firefighting most likely to contribute to role ambiguity, role conflict, and role overload in firefighting. Role ambiguity is reduced by defining what to do, when to do it, how to do it, and how to coordinate with teammates. Role overload is reduced either by causing changes in the person's ability level (physical training to improve strength) or permitting the person to develop strategies that make more efficient use of his or her abilities. Role conflict is reduced by providing experience in distributing tasks across team members and prioritizing tasks when more than one is required at a given time.

Results of Interviews with Instructors

During the conversations with instructors, the following areas were defined: content areas in firefighting that were most difficult for recruits, content areas that were easiest for recruits, and information they brought to firefighting training. Instructors denied that there were areas which were more difficult for females than males, although they thought that the recent removal of the technical detail in the course and in the tests contributed greatly to this perception. In the past, when the course held more technical data, females, who presumably had less experience with pumps and other mechanical equipment, had a significant failure rate in the academic portion of firefighting training. Since recruits can be "put back," that is, required to repeat the course of instruction up to two times, failure has a significant impact on the recruit, training schedules, and total recruit throughput.

The instructors indicated that women were at a disadvantage in their lack of mechanical knowledge in understanding how pumps and dewatering equipment worked. They stated that females were at an advantage in both academic and hands-on firefighting training because they tended to pay attention more in class and asked questions. They also were more attentive in hands-on training and therefore, despite their smaller size, often did better handling the hoses. When asked if there was anything the recruits already knew that helped them with firefighting training, instructors said that those with prior volunteer firefighting experience were at an advantage. It was usually males who had this advantage.

A group of instructors was interviewed using an open-ended questionnaire. The answers shown are compilations of instructor comments. In some cases the answers do not seem to be exactly matched to the questions. These are the answers that were given.

- ***What are the most difficult areas of firefighting training for recruits?*** Fire extinguishing systems, components of the fire extinguishing and dewatering systems, differentiating between portable

extinguishers, and information on the OBA [Oxygen Breathing Apparatus]. Recruits do NOT have problems learning what to use for particular fires.

- ***What are the easiest areas of firefighting training for recruits?*** The content areas which instructors presented as easiest for recruits were the SEED [Supplementary Emergency Egress Device], classes of fire, and compartment identification.

- ***Is there anything the students know before recruit training that helps them with firefighting training?*** Ex-volunteer firefighters know a lot. Females are more attentive in class. Ask more questions. Feel they have more to learn. Females work harder. Males have stuff they can relate to such as mechanical equipment. [We also learned that there is, or soon will be, a Team Training lab. RDCs will be able to take recruits who are having problems either before, during, or after training, to handle the damage control equipment. Instructors also said the best improvement is good films.]

- ***What are the safety considerations in firefighting training?*** What you wear; how you handle equipment; communication; who's in charge; follow directions; stay with the team; don't be a hero. Teamwork is essential.

- ***How do women do with safety?*** No difference between males and females.

- ***What are the necessary communication skills in firefighting/ship handling?*** Speak loud and clear. Use the correct terminology. Repeat everything back. Tell person to do it. He'll repeat. Two-way communication. Keep all communications short and to the point. Be able to use the sound-powered phone.

- ***What special skills do women need that they don't have?*** If you don't pull your load, you'll get yelled at regardless of race or gender.

- ***What teamwork skills are needed in firefighting/ship handling?*** Establish who's in charge. Be able to take or give orders. Realize that if my shipmate doesn't make it, I don't either. Teamwork is fostered in recruit training by use of Chain of Command and using the group average to gain academic flags.

- ***What are the qualities of a good leader?*** Confidence - from experience Know what you're doing. Patience. Good Listener. Realize that the people who work for you are the ones who got you where you are. Make quick, decisive decisions. People have to have confidence in you. Take responsibility for mistakes. "Step up to the plate." Ask subordinates for suggestions. "Gain respect if you make good, quick decisions. Can make mistakes, but must be willing to take responsibility." "How you portray yourself" is important.

- ***How do you get confidence?*** Knowledge gives you confidence. On the ship, everybody drills, every day.

- ***What are the necessary non-verbal communication skills?*** Personal appearance. Eye contact. Hand gestures.

The instructors identified the areas of teamwork, communication, leadership, and safety as important skills for effective firefighting training. They provided initial information on these basic underlying skills. On a subsequent trip, seven instructors were interviewed in a content analysis on these four important skills, which formed the basis for development of the storyboards for the Role Modeling treatment.

Results of Interviews with RDCs

RDCs are responsible for guiding recruit divisions throughout their bootcamp experience. They often take responsibility for helping recruits with the academic component of their training by tutoring, providing study time, assigning one recruit to direct study, and requesting that instructors provide after-class tutoring. Four RDCs (three male and one female) were interviewed using an open-ended questionnaire. The RDCs who were interviewed also happened to be damage control specialists.

Prior to answering the questions, the RDCs offered the following opinions about the firefighting course. They stated that the course breaks down equipment into too much detail. They also said the course should simplify what they learn, teach correct terminology, and familiarize recruits with terminology. They stated that recruits need to ask more questions during class. This group of RDCs start teaching in quarters before the recruits go to class so the students understand the material in class. He goes through the Training Guide to familiarize recruits with the content. He finds that it makes them more hungry for the knowledge when they know something about it. The following are the questions and composite answers of the RDCs interviewed.

- ***What areas do recruits find most difficult in firefighting training?*** Components (e.g., Halon, AFFF, fixed CO^2, portable). Compartmentation (street map). Materials and conditions of readiness. [When asked about the closures and markings we were told that the percentage of closures on a typical ship are: X - 25%, Y - 25%, and Z - 50%.] Need to learn common sense about what to use. E.g., if there is a fire in a can, put the lid on. If there is a small fire, maybe water is the best extinguishing agent, but it isn't necessary to put a whole lot of water in a compartment when you can use a portable CO^2 extinguisher.

- ***What background helps students to succeed in firefighting training?*** Tell them, "This will be fun." Civilian firefighting, although ship firefighting is harder. Understanding there is no time to waste. You have to get the heat down. Can't use unlimited water. There's nowhere to go. You have to train to the problem - shipboard firefighting. E.g., You have to dewater. You have to remove the toxic atmosphere - not everybody has an OBA.

- ***What examples do you use to help the recruits get it? What examples do you use with the females?*** There will soon be a DC locker where recruits can have hands-on experience. [RDCs believe that this lab will help females more because they have a harder time grasping the mechanical aspects of the training.] Anything they can do to "touch" will help. Put hands on equipment before, during, or after academics. "Do it, feel it." Video "Seven Sailors" shows mistakes. Females are different from the males. They take a longer time at night study. They need time to relax. If you scream at them, they won't learn. Need to get both males and females to relax.

- ***What are the safety considerations in firefighting/ship handling training?*** Safety is paramount. Attention to details around you (situational awareness). No horseplay. Pay attention. Think/plan ahead. Cleanliness and good housekeeping. Need to know specific safety hazards for each piece of equipment. Training must cover hazards. Have a plan (i.e., a plan of escape). Realize "one guy's mistake can kill a whole ship"

- ***What could women do better in terms of safety?*** Sometimes the women get complacent, giggly. They need to be serious. [RDCs say they promote the idea of guys providing protection to the females.]

- ***What communications, leadership, teamwork skills do women need that they don't have?*** Males use more tact than females. Females are protective of space. Males are more secretive. Women burst into tears. In PT, females will never quit in front of males. Males will never quit in front of females.

- ***What communication skills are necessary for firefighting/ship handling? What skills do women need that they don't have?*** Speak clearly. If they have an accent, they won't be used as phone talkers. Females don't need to be told to talk [not what we observed at the lab]. Females tend to say too much. Need to learn to be brief. Women need to be forward. Women need to be assertive. They need to be taught to answer like they mean it. Women need to be more confident—get over tentativeness.

- ***What teamwork skills are needed for firefighting and ship handling? What skills do women need that they don't have?*** Need to follow orders. Need to be confident in the equipment. The U.S. Navy has the BEST firefighting equipment. Recruits need to realize this. Females have problems following orders from other females.

- ***What leadership skills are necessary for firefighting/ship handling? What skills do women need to be good leaders?*** Must be willing to take charge. Must not be scared to give directions. Must not be afraid that someone won't like them if they give orders. Must be able to assess the situation. Must be able to take orders. Must talk to others the way they want to be talked to.

- ***How is team building fostered in recruit training?*** Team sports. Show them how to be responsible for each other (all suffer for each other). Teach them to pay attention to detail "cog in gear." Teach them to look out for each other. Use a chain of command. Having an open door policy of chain of command doesn't work. Teach communication skills. How to talk and listen. How to talk up the chain of command and how to talk down the chain of command. Teach them to pick up body clues and use sign language. Recruits learn from each other. Learn to establish eye contact and repeat back to make sure that everybody knows what they are supposed to do.

- ***What are the qualities of the ideal recruit/firefighter?*** Confidence. Self-discipline. Be open to learning. Be subordinate when that is their role. Adaptable. Accountable - admit an error immediately. Be truthful. Be willing.

- ***How do you build confidence?*** Be firm. If they do anything positive, give positive feedback. Don't be negative. Repetition breeds confidence.

Results of Interviews with Students

Male and female recruits were interviewed at Great Lakes during the analysis. There were several different student interview sessions: male and female recruits interviewed during Special Olympics, female recruits at the end of boot camp, male recruits at the end of boot camp.

Recruits Interviewed during Special Olympics

The analysts interviewed seven recruits from Division 906 during DC Olympics (five males, two females). These recruits are in a mixed division, and it is also a "special" division. The 906 division is composed of recruits who are in the band, drill team, etc. They are generally considered to be "elite" recruits in terms of ability, behavior, and dedication. Each recruit was interviewed separately using a questionnaire with open-ended questions. Answers indicated here are composites of responses received from all recruits, since recruits often agreed in substance.

- *How well did you think you did during all of recruit training?* Did pretty well; hard in the beginning but got better; became more physically fit so it got easier as it went along. Became close within the division and to brother/sister division and they helped make it easier by encouragement, support, working out, protection from other divisions (male). [The last comments were from female recruits.]

- *How well did you do during firefighting training?* Did pretty well individually and as a group; our division averaged 46 out of 50 on the academic test].

- *Did your training increase or decrease your confidence in your ability to fight a fire?* All felt that they can [are prepared] to fight a fire on ship but expect more training on the subject in the future. But if they had to, in an emergency, they could.

- *Do you think there was any difference in how well the men and women performed during firefighting training?* No difference in how men/women performed on content test or simulator. No difference in knowledge or strength; no fear of fighting fire with men/women in mixed groups. [We observed that groups were not mixed during the simulator portion of the training, for the most part.]

- *Is there anything about firefighting training that you would change?* Would like the hands-on part to be longer. Learned more in night studies for tests (all subjects) than in classroom portion. Boring sitting there listening so long every day. Learned more in night study from the Education Petty Officer (EPO) [another recruit appointed by the RDC].

- *What parts of your recruit training were most difficult? Easiest?* Difficult: Adapting to culture and new life-style, stopping urge to say no and fight back, physical fitness in the beginning, and getting used to others' attitudes and personalities. Easiest: Physical fitness after first or second test because in shape. In firefighting training academics were easy; hands-on was more difficult.

- *What parts of your firefighting training were most difficult? Easiest?* Difficult: Staying awake in class. Easiest: Fighting fire [in simulator], memorizing content (easy) for test. Academics were easy. Would have liked more time for hands-on. Studied at night. Would have liked more realistic training, although during the hands-on, there was some adrenaline [even though it was very controlled].

- *Do you think there will be any problems with men and women performing together on firefighting teams on ships?* No problem. No difference between men/women in the simulator. When you have to fight a fire it doesn't matter who is standing next to you. [In recruit training, in the larger training groups, women were together and men were together even though they were in a mixed division. Instructors guided students through firefighting roles. We noticed that men helped women more with donning their gear than vice versa.]

- *Did you understand why firefighting training is part of your recruit training?* Yes, survival. The only person responsible for damage control is me.

- *What did you know before firefighting training that helped you to succeed in firefighting training?* Nothing, one recruit was safety martial in high school. Didn't know firefighting was something he had to learn in the Navy.

- *Was there any information in firefighting training that you think needed more emphasis?* No.

- *Was there any information in firefighting training that you think needed less emphasis?* No.

Interview with a Group of Female Recruits

The analysts also interviewed a group of female recruits from one division in a round-table format. These recruits had almost completed recruit training. They were proud of themselves although there were two who said they'd never do it again. Still they were looking forward to serving in the Navy. There was one female, who seemed to have prior leadership experience, whom everyone agreed had exhibited outstanding leadership skills during her performance as leader of Service Week activities in the galley. They were so anxious to talk that not all of the prepared questions were asked, but they presented a lot of valuable information. They also said that they felt better just for having the opportunity to talk. The following is the information offered.

- The hard part is being cooped up in quarters with so many females. So many personalities. They get on each others' nerves. "Trapped with 77 girls." It was a break to leave the compartment. They cooperated more in activities outside the compartment.

- It's easier to work with males. Hard to take orders from females. [They believe that in the fleet it will be easier to work with females because there will be time to step back. Sort of count to ten. Also they believe there will be more privacy on the ship.] In recruit training there is no way to get rid of frustrations.

- It's easier to work with females in small groups. In the compartments it's difficult to get along and work together.

- They loved Service Week. They worked 18 hours in the galley. One reason they think they'll do better in the fleet is they'll do more work of this time and be less cooped up with other females. There was a good chain of command. They worked well together. It relieved stress to be away from the whole division.

This group of female recruits answered the following questions. Answers shown are composites of individual answers.

- *Do you think the same (successful) leadership style works on males?* For males, if you say it, they'll do it. You need to be more aggressive with females. You have to be pushy. Can't use the same style. Females don't know how to work it out. They immediately go to the RDC [authority]. Then you get written up. This builds up more anger.

- *What about teamwork?* One problem is you cannot talk. "How can you get along without getting to talk?" For the first few weeks you can't talk at all. Need to talk. Nobody knows each other.

- *What about RDCs helping with academics?* Recruit (EPO) helps them with tutoring. RDCs don't really understand. Confuse more than help. Wasted time in group studies. Tutoring works better. Females get it by talking it out. Sit and listen.

- *What was difficult about firefighting training?* Application was fun. Classes were too long. Classes were held after Service Week and after 18-hour days they were tired. Content was not too hard except all the names.

- *What subjects were most difficult?* They liked classes. Material was not difficult. The most difficult part was staying awake. Didn't do enough PT.

- *What communication skills are necessary?* Learn how to identify different personalities. How different personalities respond to different methods. Need a leadership class. Need to evaluate leaders.

- *What are the characteristics of a good leader?* Tries to make others successful. Works to make everyone succeed. Doesn't sit back. Helps other people. Leaders should practice what they preach. Takes care of shipmates. Doesn't look for ways to turn people in to the RDCs. Resolve conflicts. Draw the line. They observed that guys do it differently. They handle problems physically. Then they drop it. Females hold grudges.

- *How about teamwork?* Better with males.

Interview with Male Recruits

The analysts interviewed a group of males who had almost completed boot camp. This group contained the Section Leaders, RPOC, Master of Arms of their 79-person division. There was only one recruit who did not have a leadership role in the division. Time was limited, so only the following open-ended questions were answered.

- *What are the important leadership skills?* Be down on self if errors are made. Take responsibility. Show a good example. "Best leader is the best follower."

- *How do females and males handle teamwork differently?* RPOC does what the RDC tells them. The males seem to understand this and not resent what they are told to do. [This group was composed of leaders.] They know if they don't do things the RDC will yell. Males use the chain of command. The effort is to "keep it in house." Comparing males and females: "females exhibit more friendship; males exhibit more teamwork."

- *How was firefighting training?* Needed more hands-on. Content was not difficult. They didn't do that well in the test because they had had a rough day and a wild week. They had lots of study time. They had the answers in their Study Guides before they went to class.

What are the most important aspects of safety training? Pay attention to detail.

What are the most important communication skills? Hand signals. Cover all bases. Look in everyone's eyes to be sure they're getting it. Be very specific. With so many people if someone doesn't get it or asks questions, it "spreads like wildfire."

Observation

During the course of the first year, the analysis team traveled to Great Lakes three times. On each trip, there were changes to the curriculum.

Academic and Classroom Instruction

The research team discovered various changes to the academic component of the firefighting course which had taken place after the proposal was written but prior to the beginning of this project. These changes have resulted in an overall increase in recruit scores on the academic tests, and a smaller difference between male and female scores on the academic tests. Changes to the academic component of firefighting training include moving firefighting training to week seven of the nine-week boot camp. By the time they begin firefighting training, the recruits are deeper in the acculturation process and the

atmosphere of basic training. Recruits indicated that they had more time to study at this later stage of boot camp than they had earlier. They are more adapted to the demands of the physical fitness component of recruit training because they are more physically fit. Highly technical material was removed from the curriculum and tests. Some recruits received academic tutoring prior to and during firefighting training from RDCs and instructors. This is important because, although recruits are not attrited for academic failure, they can be put back (required to repeat the week of training) up to twice for failing the academic test. It should be noted that, although changes have resulted in a greater parity between males and females in the academic portion of the course, the research team found that more females fail the academic test and thus are set back at a greater rate than males.

Throughout the first year of the project, the research team discovered changes to the hands-on component of the firefighting course as well. During the first visit, the research team learned that performance in a hierarchical team structure (fire party) was not part of the firefighting training at Recruit Training Center (RTC). On the first trip, January 9-14, recruits spent approximately 12 hours (three half-days) in the classroom. Some students were not there at all due to other requirements. The team was told that statistical data shows no correlation between class attendance and scores on the academic test. Recruits spent approximately 2-3 hours in the simulator. Simulator activities were not graded. In the simulator, recruits spent some time observing. They performed other activities (donning and removing protective gear and performing in hose teams) as directed by the instructor.

On a later visit, the hands-on component of firefighting training had changed. As of this writing, after the guided hands-on exercises, recruits participate in an "unguided" Team Training exercise in which they perform the same activities without as much instructor intervention. There are objectives and a checklist for instructors to rate each team as satisfactory or unsatisfactory on each performance objective. There was no indication that these group scores would be used to put recruits back or result in any form of remediation. Recruits also take part in a firefighting scenario as part of the all-night training exercise modeled on the Marine "crucible concept" training experience. Recruits do not receive group or individual scores in this exercise.

Recruit/Instructor Ratio

Usually two divisions attended classroom training together, providing a 160/1 recruit/instructor ratio for academic instruction. Occasionally only one division would be in the classroom, providing an 80/1 recruit/instructor ratio. Since male/female divisions are generally paired, women will usually be part of the larger group with a 160/1 recruit/instructor ratio, except when they are part of an integrated division.

In hands-on training in the simulator, one to four divisions participate. A group of instructors ensures that each group comprising two hose teams has at least one instructor and one instructor takes students through the smoke room. There is additional staff monitoring safety.

Hands-On Performance in the Simulator

During the performance (simulator) portion of the course, recruits are not really required to make decisions, etc. They help each other don the equipment and get the feel of holding the nozzles and hoses for the different types of fires. In a large group (not stragglers), the women were on teams with other women only, not on mixed teams. Instructors say women are often more aggressive in "fighting" the fires than male recruits. This is a highly structured situation where the performance requirement is clearly defined and limited. Being "aggressive" is leaning into the fire, holding the hose correctly—i.e., exactly as taught. There is no sense of danger in the simulator. The analysts noticed that males helped the females more donning their equipment than the other way around.

Data Review

The following materials related to firefighting training were collected and reviewed. (1) *Lesson Plan* containing the text of the instructor lectures, objectives, slides, and all video tapes identified in the Lesson Plan. This comprised all of the instructional content of the academic firefighting course. All instructors follow the same Lesson Plan. (2) *Student Guide* which contains the same material as the Lesson Plan with blanks for students to enter information during class. In addition, the Lesson Plan and Student Guide for the Ship Handling curriculum were reviewed.

Data on male/female test performance was also gathered and analyzed. In addition, a study performed at RTC by Dr. Slater was provided. This study analyzed the differences in male/female performance in the academic area of firefighting training after the changes to the academic component of the firefighting course.

Summary of Training Requirements

Advance Organizer Treatment

The following is an outline of the material presented in the academic portion of firefighting training. The Advance Organizer treatment will provide an overview and introduction to these topics.

Basic Damage Control

1. Ship's watertight compartments. Divided by decks and bulkheads.

    a. Purpose - Explain and give examples of each purpose

        (1) Control the spread of fire and flooding
        (2) Withstand chemical, biological, and radiological attacks
        (3) Divide the ship into spaces
        (4) Provide underwater protection with tanks and voids
        (5) Control stability and buoyancy

    b. Compartment ID system

        (1) Deck or level
        (2) Forwardmost frame in the compartment
        (3) Relation of the compartment to the ship's centerline
        (4) Compartment's primary use

2. Shipboard Closures - Watertight fittings

    a. Types

        (1) Watertight doors
        (2) Hatch
        (3) Escape scuttle

    b. ID Numbers

        (1) Deck/level

(2) Frame Number
(3) Fitting's relationship to centerline

3. Material Conditions of Readiness

a. Three basic: X-ray, Yoke, Zebra - from X only closed to X, Y, and Z closed.

b. Special purpose: Circle X-Ray and Circle Yoke, Circle Zebra, Dog Zebra, William, Circle William

4. Managing Damage Control

a. Documents

(1) Closure log
(2) Compartment checkoff list

b. Damage Control Central

c. Damage Control Communications

(1) Sound-powered telephone
(2) Ship's service telephone
(3) Ship's loudspeaker or general announcing system
(4) Messengers

d. Ship's Emergency Alarms

(1) General alarm
(2) Chemical alarm
(3) Collision alarm

5. Hazardous Material Documents

a. Labels

b. Material Safety Data Sheets

6. Methods of Correcting Damage to the Ship During Emergencies

a. Shoring

b. Patching and Plugging

7. Damage Control Prevention

<u>Damage Control Dewatering Equipment</u>

1. P-250 MOD-1 Portable Pump

2. P-100 Portable Pump

3. Portable Eductors

4. Portable Electric Submersible Pump

Emergency Escape Breathing Device (EEBD) and Supplementary Emergency Egress Device (SEED) and Oxygen Breathing Apparatus (OBA)

1. Emergency Escape Breathing Device

2. Supplementary Emergency Egress Device

3. Oxygen Breathing Apparatus

Chemistry and Classes of Fires

1. Extinguishing a Fire Using the Principles of the Tetrahedron

Remove oxygen	Non-combustible gases (CO^2) Aqueous film forming foam (AFFF) - forms a blanket over the surface of a burning liquid to cut off the air supply to the fire
Remove fuel	Closing fuel oil supply lines Jettisoning a burning aircraft over the side Moving combustible materials to a safe area
Remove heat	Water AFFF
Interrupt Chemical Chain Reaction	Halon Potassium bicarbonate (PKP)

2. Extinguishing Agents for the Classes of Fire

Table A - 1. Extinguishing Agents for Classes of Fire

Class Of Fire	Materials	Characteristics	Extinguishing Agents	Principle	Effective Use
ALPHA	Wood, paper, cloth	Leaves ashes or embers	(1) Water (high-velocity fog, solid stream)	Reduces heat	Most common and available agent.
			(2) Carbon Dioxide (CO^2)	Displaces oxygen	Most effective in small confined spaces. Does not prevent reflash.
BRAVO	Fuel oil, kerosene, liquid paint	Involves flammable liquid or gases	(1) Aqueous Film Forming Foam (AFFF)	Smothers fire by cutting off oxygen. Forms a vapor-tight seal over a burning liquid.	Prevents reflash.
			(2)Potassium bicarbonate dry chemical (PKP)	Interrupts chemical reaction	Most effective on small fires. Does not prevent reflash.
			(3) High-velocity water fog (Never use a solid stream)	Reduces heat	A solid stream will spread the fire.
			(4) Halon 1301	Interrupts chemical reaction	Soap-like solution. Used in ship's galley to extinguish burning cooking oil and grease.
			(5) CO^2	Reduces heat	
			(6) Aqueous potassium carbonate	Smothers the fire (cuts off oxygen)	
CHARLIE	Electrical equipment	Electrical power should be secured before attacking fire.	(1) CO^2	Reduces heat	
			(2) High-velocity water fog	Reduces heat	
			(3) PKP	Interrupts chemical reaction	Use only as a last resort because it will further damage electrical equipment due to corrosion.

Class Of Fire	Materials	Characteristics	Extinguishing Agents	Principle	Effective Use
DELTA	Combustible metals and hazardous materials		(1) Jettison (2) Low-velocity water fog		Never use a solid stream of water. Burning magnesium will break down a solid stream of water into its basic elements (H_2O) and cause an explosion.

3. Fire Prevention

   a. Keep working and living areas clean.
   b. Keep electrical appliances in good working order.
   c. Safeguard all flammable products.

      (1) Heat from sources such as cigarettes and torches could ignite flammable vapors.
      (2) Flammable vapors are heavier than air and flow downward.

Portable and Fixed Fire Extinguishing Systems

1. Portable fire extinguishers

   a. CO^2 Fire Extinguisher

      (1) Purpose - Primarily for class "C" fires. May be used for small localized class "A" and "B" fires.

      (2) Components
      (3) Operating procedures
      (4) Safety precautions

   b. Potassium Bicarbonate (PKP)

      (1) Purpose - Primary class "B" fires. Class "C" fires as a last resort.
      (2) Components
      (3) Operating procedures
      (4) Safety precautions

2. Fixed Fire CO^2 Fire Extinguishing Systems

   a. Hose and Reel

      (1) Purpose - extinguish class "C" fires in main machinery spaces
      (2) Components

b. Fixed Flooding

(1) Purpose - extinguish large fires in spaces NOT normally occupied by personnel, e.g., flammable liquid storage lockers, paint lockers
(2) Components
(3) Safety precautions

3. Halon 1301 Fire Extinguishing System

a. Purpose - Protects machinery spaces and flammable liquid storage rooms from class "B" fires which cannot be extinguished by initial watchstander alone.
b. Components
c. Safety Precautions

4. Firemain System

a. Purpose - Supplies firefighting water to the ship
b. Components
c. Operating Procedures
d. Safety Precautions

5. Aqueous Film Forming Foam (AFFF) System

a. Purpose - To protect spaces from class "B" fires, such as flight decks, well decks, machinery spaces. Uses a solution of AFFF concentrate and sea water to fight fires.

b. Components

6. High Capacity AFFF System

a. Purpose- Combat large class "B" fires, e.g., hangar bays, flight decks, and well decks.

7. Portable Inline Eductor (Portable AFFF System)

a. Purpose - Used in a portable AFFF system to mix AFFF concentrate with seawater.
b. Accessories - Pick up tube, crow's foot
c. How it works

8. Naval Firefighter's Thermal Imager (NFTI)

a. Purpose - Gives firefighters the ability to see the fire through dense smoke and locate trapped personnel
b. Components

9. Fire Finder

   a. Purpose - Gives firefighting personnel the ability to locate fires in spaces filled with smoke and "hot spots" on bulkheads and overheads.
   b. Components

10. Naval Firefighters Thermal Imager - Shows a TV-like black and white image. Looks like a negative picture. Hotter objects appear lighter than cooler objects. Primarily functions to help locate the fire when smoke or darkness restricts visibility. Also useful for assessing temperature from outside a compartment. Later used by reflash watch to detect hot spots.

General Firefighting Procedures and Fire Party Organization

1. Fire Reporting Procedures

   a. Report the fire by the fastest means to the OOD
   b. Give information: type, location by compartment number and noun name, e.g., 2-90-1-L, mess deck, your name, rank and telephone number.
   c. If fire is small, attempt to extinguish. If necessary, try to prevent spreading by closing all doors and hatches and securing the ventilation.
   d. If the fire gets out of control, evacuate all personnel.

2. Methods of Sounding the Alarm for a Fire Aboard Ship

   a. AT SEA, a fire alarm can be given:

      (1) Over the ship's 1MC announcing system

         (a) General alarm sounded followed by a message telling location of the fire by location in the following sequence: (1) rapid ringing, (2) pause, (3) one (forward), two (amidships) or three (aft) rings to indicate the location of the fire, (4) pause, (5) repeat sequence.

      (2) By word of mouth

         (a) Less effective due to time involved.
         (b) Should only be used when other forms of sounding the alarm have failed.

   b. IN PORT, a fire alarm can be given by:

      (1) Rapid ringing of the ship's bell over the 1 MC system—as at sea.

      (2) Word of mouth

3. Crew's Response to a Fire Alarm

   a. When a fire alarm is sounded at sea, the at-sea fire party responds to the casualty.

   b. If the fire is not under control in five minutes, general quarters is sounded.

c. When a fire alarm is sounded in port, the duty-in-port fire party proceeds to the scene and fights the fire.

4. Fire Party Personnel

a. A LARGE firefighting party requires strict organization and dependable communication.

b. Organization and communication are important for all PERSONNEL involved in firefighting:

(1) Scene leader - in charge of firefighting teams.

(2) Team leader - in charge of the hose teams; operates NFTI

(3) On-scene sound-powered phone talker - maintains communication between personnel at the scene of the fire and the repair locker or DC Central.

(4) Messenger - carries written messages between the scene leader and repair locker/DCCC/on-scene phone talker.

c. Every firefighting team has two HOSE TEAMS. #1 Hose team (attack team) #2 Hose team (backup/supporting team)

(1) Nozzleman - controls flow of water onto the fire as directed by the team leader.

(2) Hosemen - lead out the hoses from the fire plug. Remove kinks and sharp bends from the hose.

(3) Plugman - Stands by to open or close fire plug valves when ordered. Rigs jumper hoses.

(4) Investigators - Inspects spaces adjoining the fire for further damage, personnel casualties, fire and smoke boundaries. Operates the Fire Finder.

(5) Boundary men - Establish and maintain fire boundaries. Isolate the fire by closing doors, hatches, etc.

(6) Access men - Clear routes to gain access to the fire. Open doors and hatches. Carry equipment necessary to open jammed fittings and locked doors.

d. Other supporting personnel and equipment teams provide special skills, as needed, to extinguish the fire.

(1) Electrician - Secures electrical power in the affected area as directed. Rigs power cables for portable lights, tools, and blowers.

(2) Dewatering/desmoking equipment team - Removes water and smoke from affected spaces.

(3) Agent supply man - brings portable PKP and CO2 fire extinguishers to the scene.

6. Basic Rules of Firefighting

a. Isolate the fire - close all doors, hatches, and vents.

b. The electrician will secure power sources when ordered. All electrical power supplied to areas affected by the fire should be shut down.

c. The scene leader will decide:

(1) To use one or more hoses to attack the fire.

(2) When to charge the hose(s).

(3) The protective equipment to be worn by the firefighters.

(a) Firefighting ensemble - helmet, antiflash hood, gloves, hard soles, steel-toed boots.

(b) Oxygen breathing apparatus (OBA).

d. Set fire boundaries in surrounding compartments.

(1) Remove combustible materials.

(2) Station personnel with hoses at fire boundaries to cool bulkheads and decks.

e. Rig portable pumps - used if firemain pressure is lost; e.g., P-250/P-100.

f. Combat fire from best possible position to protect personnel.

g. Keep investigating the surrounding areas until fire is completely out.

h. The scene leader makes continual progress reports to Damage Control Central.

Role Modeling Treatment

The content of the Role Modeling treatment was derived from a combination of (1) a literature review of gender differences in personal skills development, attitudes, and team building; (2) observation in the

seamanship lab, and (3) interviews with Navy personnel. After analyzing the materials gathered, it was determined that the areas to be addressed in the Role Modeling treatment are safety, teamwork, communication, and leadership. These were presented in the Treatment Plan and were approved by the Navy. Content in each of the four areas was derived from extensive interviews with firefighting instructors prior to development of the storyboard for the Role Modeling treatment.

Safety

- *Observation of Seamanship Lab*
    - "Safety" person must watch carefully.
    - Don't do anything until you are told by person in charge.
    - When it's a safety issue, you'll really get "chewed out."
- *Interviews with firefighting instructors:*
    - Must wear proper garb.
    - Must handle equipment correctly.
    - Must communicate correctly.
    - Must know who's in charge and follow directions.
    - Stay with the team. Don't be a hero. Remember the Forrestal.
    - Practice teamwork.

    (No difference in how women do with safety)
- *Interviews with RDCs, who were firefighting experts*
    - Safety is paramount.
    - Attention to details around you, how to egress, what's in your way - situational awareness.
    - No horseplay.
    - Pay attention.
    - Think/plan ahead, Have an escape plan.
    - Cleanliness and good housekeeping - prevention.
    - Know safety hazards for each piece of firefighting equipment.
    - Realize "one guy's mistake can kill a whole ship."

    (Women get complacent, giggly. Need to be serious.)
- *Interviews with male recruits*
    - Pay attention to detail.

Communication

- *Observation of Seamanship Lab*
    - Talk loud, forcefully.
    - Use the exact terminology.
    - Pass messages correctly.

- *Interviews with firefighting instructors*:

    - Speak loud and clear.
    - Use the correct terminology.
    - Repeat everything back.
    - Keep all communications short and to the point.
    - Be able to use the sound-powered phone.
    - Non-verbal communication skills - personal appearance, eye contact, hand gestures.

    (women - if you don't pull your load you'll get yelled at.)

- *Interviews with RDCs, who were firefighting experts*

    - Speak clearly.
    - If they have a heavy accent, they won't be used as phone talkers.
    - Females don't need to be told to talk [not what we observed].
    - Females tend to say too much. Need to learn to be brief.
    - Women need to be forward, assertive. Answer like you mean it.
    - Be more confident. Get over tentativeness.

    Communication, leadership, teamwork skills that women need that they don't have.

        - Males use more tact than females.
        - Females are more protective of space.
        - Males are more secretive.
        - Females burst into tears.
        - In PT, females will never quit for males and males will never quit for females.

- *Interviews with female recruits*

    - Learn how to identify different personalities. How different personalities respond to different methods.
    - Need a leadership class.
    - Need to evaluate leaders.

- *Interviews with male recruits*

    - Hand signals.
    - Cover all bases.
    - Look in everyone's eyes to be sure they're getting it.
    - Be very specific. With so many people, if someone asks questions, it spreads like wildfire.

<u>Teamwork</u>

- *Observation of Seamanship Lab*

    - Each person has a well-defined role.
    - Everything is carefully coordinated.
    - Things are done in order; order is well-known to all.

- *Interviews with firefighting instructors:*

    - Establish who's in charge.
    - Be able to take or give orders.
    - Realize that if my shipmate doesn't make it, I don't either.
    - Teamwork is fostered in recruit training by use of chain of command, group average for "flags", and intensive training (IT).

- *Interviews with RDCs, who were firefighting experts*

    - Need ESP.
    - Need to follow orders.
    - Need to be confident in the equipment. "The U.S. Navy has the BEST firefighting equipment. Recruits need to realize this."
    - Females have problems following orders from other females.

      (In talking to recruits there was a lot of discussion about how males take care of the problem at the lowest level possible. Females kick the problem upstairs. Females don't like female bosses. Especially if they are autocratic, or mean. - Are they really or is that how they are perceived?)

- *Interviews with female recruits*

    - Need to be able to talk to be able to get along enough for teamwork.

- *From Salas et al. (1995)*

    - Teamwork includes behaviors such as mutual performance monitoring, backup behavior, intrateam feedback, and a belief on the part of team members that they are a group whose success depends on their interaction.

    - Dimensions of teamwork: communication, adaptability, cooperation, acceptance of suggestions or criticism, giving suggestions or criticism, team spirit, and cooperation.

<u>Leadership</u>

- *Observation of Seamanship Lab*

    - Recruits learn leadership by taking leadership roles.
    - Leaders must forcefully tell others what to do.
    - Order must come from your line captain, not somebody else's.
    - Must watch carefully before giving orders.
    - "Dog wags the tail."

- *Interviews with firefighting instructors: (Asked for qualities of a good leader)*

    - Confidence - which is gained from experience, knowledge.
    - Know what you're doing.
    - Patience.
    - Good listener.

- Realize that the people who work for you are responsible for your success.
- People have to have confidence in you.
- Take responsibility for mistakes "Step up to the plate."
- Ask subordinates for suggestions.
- Be able to make quick decisions.
- How you "portray" yourself.

- *Interviews with RDCs, who were firefighting experts*

  - Must be willing to take charge.
  - Must not be afraid to give directions.
  - Must not be afraid people won't like them if they give orders.
  - Must be able to assess the situation.
  - Must be able to take orders.
  - Must talk to others the way you want to be talked to.
  - Be responsible for each other.
  - Pay attention to detail.
  - Know how to talk up and talk down the chain of command.
  - Learn to establish eye contact and repeat back so everyone knows what they are supposed to do.

  Characteristics of the ideal recruit/firefighter

  - Confidence.
  - Self-discipline.
  - Learn freely - open to learning.
  - Act subordinate when that is your role.
  - Be adaptable.
  - Be accountable - admit an error immediately.
  - Be truthful.
  - Be willing.

- *Interviews with female recruits*

  Characteristics of a good leader

  - Tries to make others successful.
  - Work to make everyone succeed.
  - Don't sit back. Help other people.
  - Leaders should practice what they preach.
  - Take care of shipmates.
  - Don't look for ways to turn people in to the RDCs.
  - Resolve conflicts (Observed that unlike males, females hold grudges.)

- *Interviews with male recruits*

    - Be down on self if errors are made.
    - Take responsibility.
    - Show a good example.
    - Best leader is the best follower.
    - Make use of chain of command.
    - Keep it in house.

APPENDIX B

DEVELOPMENT OF A STRESS ASSESSMENT PROFILE FOR RECRUIT FIREFIGHTING TRAINING

INTRODUCTION

Background

This report describes the development of a Stress Assessment Profile for U.S. Navy recruit firefighting training. The work described is one element of a project to improve firefighting instruction for female U.S. Navy recruits. The larger project addresses two issues in firefighting training.

One issue is that female recruits may have limited experience with technical systems and the related terminology. Traditional instructional methods assume some technical sophistication. Traditional methods also use examples and analogies that may be more familiar to males than to females. The proposed solution to this problem is a multimedia presentation that will provide context and structure for the materials to be presented in firefighting training. This presentation, referred to as the advance organizer, will be designed to give female recruits an integrated frame of reference for extracting, structuring, and storing information presented in firefighting classes.

The project also will address a possible problem with self-efficacy in female recruits during firefighting. Some females may lack experience in similar team-oriented, physically challenging, high-risk situations. This lack of experience may leave them uncertain about their ability to meet the requirements of firefighting training. A second multimedia presentation will be developed to show a female role model or models coping effectively with the demands of firefighting training. The role model(s) will demonstrate the thought processes and behaviors required to ensure proper problem solving for effective firefighting.

Both multimedia training modules are intended to improve the performance of female recruits. One general study hypothesis is that performance improvement will be mediated by reductions in role stress and increases in self-efficacy. The overall project design, therefore, requires assessments of stress in firefighting training. The protocol described in this application adapts stress measures developed in previous recruit research (1,2) to provide those assessments.

Objectives

The primary objective of the work carried out this year was to provide a set of psychometrically sound stress measures. Previous research indicates that similar scales have acceptable psychometrics when recruits are asked about (1) basic training in general or (2) about specific phases of basic training. However, the scales have not been applied to evaluation of specific courses in basic training. If the scales demonstrate acceptable psychometric characteristics, the protocol also will assess gender differences in stress under the current training program.

The work also examined the development of an efficient set of measures for affective responses to training. Emotional reactions are one hallmark of exposure to stress. The reactions may vary depending on coping styles, stress levels and other factors, but stress can be expected to produce some negative emotion in a typical individual. The original research design called for an extensive assessment of mood states. The design has been modified in response to constraints imposed by the current structure of firefighting training for recruits. The development of those measures is described in the second section of the report.

Research design modifications also are considered. These modifications include a change in the structure of the treatment groups in the overall study, a change in the timing of stress assessments, and elimination of the Fleet firefighting school follow-up originally planned for the study.

Each of the preceding topics is discussed in a separate section of this report. One important outcome of this work is the Initial Firefighting Stress Questionnaire (Appendix B-1). The Initial Firefighting Stress Questionnaire contains 34 items which measure self-efficacy and perceived stress. This questionnaire will be given in Great Lakes in November to replicate results of analyses of previous data from Marine Corps results described in the sections titled "Instrument Development" and "Pretest of Role Stress Measures."

If the results replicate, most of those items for self-efficacy and perceived stress will be retained in the final Stress Evaluation Profile. It is expected that some items which did not load well in previous studies will also not load well in this study, and the items will be omitted from the Stress Evaluation Profile.

In addition, the final Stress Evaluation Profile will contain items to measure mood or affective stress. Mood/affective stress will not be tested in the Initial Firefighting Stress Questionnaire because mood structure has already been demonstrated in Navy recruits. A discussion of mood/affective stress is provided in the section titled "Affective Stress Indicators."

On the assumption that the final Stress Evaluation Profile will contain 28 self-efficacy and perceived stress items and 12 mood/affective stress items, a Prototype Stress Evaluation Profile was developed (Appendix B-2).

ASSESSMENT OF ROLE STRESS AND EFFICACY

Conceptual Approach

The stresses of firefighting training can be isolated by combining a role theory perspective on jobs with a person/environment fit model of stress (3-5). Firefighting presents recruits with a set of tasks to be performed; firefighting training instructs the recruits in the performance of those tasks. Firefighting can be thought of as a specific role which must be performed aboard ship. Firefighting training, therefore, is role training in which recruits are taught to recognize the demands represented by conditions occurring in fires, the actions required to deal with those demands, and the coordination with shipmates required to execute those actions efficiently. Effective training will inculcate the knowledge and skills required to perform the role.

Role stress arises from task demands. Previous work suggests that task demands generate three broad categories of stress. *Role ambiguity* occurs when the role incumbent is uncertain which tasks to perform or how to perform them (3,5). *Role overload* occurs when task demands exceed abilities (4). *Role conflict* occurs when a role incumbent is expected to perform two or more tasks at the same time and must choose between them. Role conflict also occurs if a single task must be performed one way to satisfy some people, but a different way to satisfy others. In each case, the theme is choosing between alternative actions (3,4). These three stresses apply to recruit training (1,2) as well as to jobs in general (4).

Stresses arise partly from communication processes. When communications lack clarity or consistency, stress is likely (3,5). On logical grounds, communication is particularly important in teamwork situations. Good communication is required to ensure that the interrelated activities of team members are properly coordinated. Poor communication increases the likelihood that two or more team members will try to perform the same task, that the team will overlook one or more critical tasks, that the timing of

performing different tasks will be less than optimal, and so on. These problems could generate any of the three types of stress noted above. The type of communication required to avoid these problems should be evident as good teamwork.

Scope of the Stress Assessment

The stress assessment scope was broadened for this preliminary work. Two facets of basic training environment were considered because they overlap conceptually and empirically with role ambiguity and role conflict in basic training (1,2). These aspects of training were (a) standardization, the degree to which behavior is controlled by setting specific methods for performing tasks; and (b) teamwork, the degree of cooperation and communication among recruits when performing tasks.

These added facets were relevant to the measurement of role ambiguity and role conflict because each facet could contribute to the target stresses. Role ambiguity could be reduced by standardization and by good communications among teammates. In fact, standardization may be a critical means of reducing the need for active communication. When roles are standardized, recruits will not need to tell each other what to do, how to do it, or who should do it. Communications can be limited to signaling that it is time to perform one's preprogrammed actions. Role conflict will increase if people do not coordinate their activities well. Failures to coordinate could result in one person receiving requests for help on two different tasks from different people at the same time.

Adding these considerations to the measurement protocol provided an opportunity to refine the measurement of the target stresses by considering both causes and effects of the stresses being measured. Psychological scales often consist only of indicators of the effects of the construct to be measured. For example, personality traits are assessed by reports or observations of behaviors that presumably are caused by the traits. The reasoning is that if many behaviors are present which would be caused by the trait, it is reasonable to infer that the person possesses the trait to a high degree. If the behaviors are missing, it is reasonable to infer that the trait is a weak influence on behavior in that individual.

Bollen and Lennox (6) have pointed out that information about causes of a trait or state also provide a basis for inferring the degree to which it is present. In the present case, for example, if the stress is caused by several organizational or instructional factors and all of those are present for an individual, it is reasonable to infer that stress is present. If all of those antecedent conditions are missing, it is unreasonable to infer that their consequence, stress, is present. Standardization and teamwork, therefore, can be useful indicators in conjunction with role ambiguity, role conflict, and overload because the elements of those scales indicate that conditions which may cause stress are present.

Self-Efficacy

Self-efficacy is an important psychological factor influencing people's willingness to perform specific behaviors (7). This concept refers to an individual's belief that he or she can perform specific behaviors. A person who has high self-efficacy will believe he or she can perform even difficult tasks. A person with low self-efficacy will believe that he or she is not likely to be able to perform tasks well even though they are relatively simple. In some theories, the intensity and duration of the effort put into a task are proportional to the strength of belief that success is possible. If female recruits believe that they cannot master the technical material in firefighting or cannot perform the physical tasks involved, they are unlikely to put maximum effort into learning the materials and performing the tasks. It is important to know, therefore, the extent of such deficiencies (if any) and the degree to which the training corrects these problems.

Self-efficacy measures assess the person's perceptions of his/her ability to perform some set of tasks. These measures often focus on specific tasks (e.g., handling a snake) or particular roles (e.g., being a counselor). Some scales assess the person's perceptions of how well he/she can handle tasks in general (7). The proposed scale to be used here adapts generalized indicators of self-efficacy to focus on the role of firefighting.

Self-efficacy may be an important qualifier of stress effects. A person who does not try hard because he or she does not believe he or she can meet task demands will fail even though he or she possesses the requisite ability. Low self-efficacy also may prevent the person from taking available actions to reduce stress (e.g., doing additional studying, asking for help). Thus, self-efficacy may affect behavior directly in ways that reduce the probability of effective performance.

Training and Stress

Effective training can reduce stress in recruit firefighting training. Training objectives include the development of a shared vocabulary for accurately defining the location and type of problem encountered. Vocabulary also includes an understanding of the equipment used in firefighting (e.g., a P-250 pump). Training includes specific orders to be given to indicate when to perform well-defined tasks. Training also teaches techniques for task performance by individuals and how to coordinate individual activities to perform as a team. Training, therefore, provides information, techniques, and skills which, once learned, should reduce the stress of firefighting.

Viewing firefighting training from a stress perspective, reduced role stress is one indication of an effective training program. This project will develop and evaluate two new tools for training. One tool is a multimedia *advance organizer*. This tool will be designed to ensure that female recruits possess relevant concepts to anchor the technical material of firefighting training. The possession of anchoring concepts that are the right level of abstraction, generality, and inclusiveness is an important influence on how quickly and how well new material is learned. The second tool is a *role modeling* videotape or multimedia presentation.

Role modeling is an effective means of changing attitudes. The modeling will involve showing recruits the action choices made by a female who has successfully mastered the elements of firefighting training. The action choices will be shown along with verbal descriptions of why one course was chosen over another. This tool should help develop the reasoning and self-control processes required to apply knowledge and abilities effectively.

The advance organizer and role modeling are expected to reduce the stress of firefighting training. Greater mastery of material should increase the probability of quickly recognizing the appropriate course of action and effectively implementing that course. Recognizing and implementing the attitudes and cognitive processes that lead to task success also should improve performance. Both types of changes should make it easier for the individual to succeed, lower the threat of failure, and produce other similar changes that correspond to the general concept of stress. The general research hypothesis, therefore, is that the tools will reduce stress. Sound stress measures are needed to evaluate this hypothesis.

INSTRUMENT DEVELOPMENT

Stress Assessments

The initial set of stress measurement items presented in the Initial Firefighting Stress Questionnaire (Appendix B-1) was constructed by combining prior attempts at measuring stress in basic training with previous assessments of generalized self-efficacy. The procedures for selecting the initial item set are described here.

Adapting Previous Scales

The instrument for assessing stress and self-efficacy was constructed by adapting measures from previous research. Most items for each stress were adapted from previous studies of basic training (1,2). While the prior studies which produced these items involved only male recruits, a review of recent stress research suggests that the hypothesized structure of the stress items should apply equally well to the present mixed-gender sample. Gender differences in stress are modest whether the issue is "How much stress is there?" or "Which items define which dimensions?"

Adding New Items

Reliance on generic stress indicators can be risky when studying a specific situation. Previous research indicates that generic stress items can be applied to different parts of basic training (2). However, even though this is true, relying solely on generic stress indicators may mean that specific aspects of the situation which determine stress are overlooked. If specific factors were the key to successful performance in the firefighting, for example, the generic stress approach could lead to incorrect inferences about stress and performance. For this reason, an attempt was made to isolate situation-specific factors which might be crucial to the accurate assessment of stress in firefighting training.

Five items were developed specifically for this study. These items address issues raised in interviews with recruits about firefighting. The interviews were conducted by Claire Bartoli of Southwest Research Institute. Transcripts were provided to the principal investigator on this protocol as part of the cooperative research plan outlined in the original research proposal. Three items represented new content that was relevant to firefighting training. These items were:

11. It is easy to remember the technical details of firefighting.

14. Team communications are clear and specific.

21. Team leaders make good, quick decisions.

Two other items were produced by splitting apart elements of what had been a single question in earlier studies. The items "Orders and explanations about what has to be done are clear" was potentially confusing in the present context. Recruits' comments indicated that they might distinguish between explanations given as part of classroom instruction and orders given in the hands-on firefighting training. Poor communication associated with orders that are not stated clearly or loudly enough to be understood during that part of training appeared to be an occasional problem. The result was that incomplete, incomprehensible orders were mentioned as a problem by recruits in their interviews. To avoid presenting respondents with a double-barreled question which might cause problems, the item was presented as:

19. Explanations about what has to be done are clear.

and

34. Orders given during firefighting are clear.

Self-Efficacy Scale

Self-efficacy items were adapted from two sources. The first source was a generalized self-efficacy measure (7) which has been widely adapted for use in specific occupations and activities. However, examination of the items in this scale suggested that many were more suitable for measuring traits expressed in a wide range of situations and/or settings rather than a single class. For example, questions about the generalized tendency to persist in the face of difficulties may be appropriate for a general setting such as recruit training taken as a whole, but not appropriate for a specific setting such as firefighting. In the latter case, the duration of the training may be too brief to produce much variability in persistence. These questions also appeared to run the risk of obtaining measures that reflected the person's broad behavioral style or traits rather than perceptions of and behavior in the specific situation. The elements of efficacy deriving from the perception of that situation were more relevant than generalized indicators.

Additional self-efficacy items were drawn from a performance expectancies scale used in prior recruit research (Vickers, unpublished data). The scale originally was designed to measure the expectancy element in a valence-incentive-expectancy (VIE) model of motivation (cf., 8) for basic training. The items incorporated into the present instrument were originally designed to measure performance expectancies. Performance expectancies are the recruit's perceptions that he or she is or will be able to perform the tasks and actions required in firefighting. This concept is very closely similar to the central elements of efficacy. Also, the scale items had the advantage of already having been tested in recruit populations.

PRE-TEST OF ROLE STRESS MEASURES

Archival data were used to pre-test the role stress measures. The specific concerns were whether adding teamwork and standardization items to the set of indicators for the target stresses of role ambiguity, role conflict, and overload would improve the measurement of those constructs.

The subset of suggested role stress items that had been employed in previous research with U.S. Marine Corps recruits (1) was analyzed. Data were available for 413 recruits who completed the questionnaire at the end of basic training.

Data Analysis Procedures

The data analysis consisted of three elements designed to identify and evaluate the best scales that could be constructed from the item set.

Test of Hypothesized Scales

Confirmatory factor analysis evaluated the dimensional complexity of the item set by comparing the following models:

A. **Uni-dimensional.** All items had loadings on a single dimension.

B. **Two-Dimensional.** Role ambiguity items and standardization items were assigned loadings on a role ambiguity dimension. Role conflict and overload items were assigned loadings on a role conflict dimension. Teamwork items were permitted to load on both dimensions. The correlation between the role ambiguity and role conflict dimensions was fixed at $\underline{r} = .00$.

C. **Five-Dimensional.** All role ambiguity items were permitted to load on one dimension, all role conflict items on a second dimension, all standardization items on a third dimension, etc. Role ambiguity and role conflict were assumed to be uncorrelated; all other correlations were assumed to differ from zero.

The working hypothesis was that Model C will fit the data better than the other models.

Results of Archival Analysis

Confirmatory Factor Analysis

As predicted, the five-dimensional model fit the data better than the alternatives (Table B-1). Parsimony adjustments would not affect this result because this model used only a few additional degrees of freedom relative to the other models. However, even the five-dimensional model provided only moderately good fit to the data. Fit indices of .900 or higher are often used as criteria for stopping the search for an improved model.

Table B - 1. Goodness of Fit for Alternative Stress Measurement Models: Conformity Factor Analysis of Archival Stress Data

Model	df	χ^2	NFI	TLI	CFI
Null	378	2212.67			
Uni-dimensional	350	1221.68	.448	.487	.525
Two-dimensional	345	9121.72	.588	.662	.691
Five-dimensional	341	636.90	.712	.821	.839

Note. df = degrees of freedom for the model. NFI = Bentler and Bonett's (19) normed fit index. TLI = Tucker and Lewis (20) index. CFI = Comparative Fit Index. See text for definition of models.

The latent trait correlations for the five-dimensional model suggest that a simpler model may be appropriate. As expected, overload and role conflict were highly correlated (r = .702). Ambiguity and standardization were even more highly correlated (r = .931). The over-substantial correlation was between teamwork and standardization (r = .742). Given that the remaining correlations were less than .230, the evidence sorted the items into an overload/conflict group and a clarity/standardization/ teamwork group. Thus, one approach would be to view these variables as components of a hierarchical stress model with concepts such as task volume and role definition as the higher-order constructs.

Table B - 2. Latent Trait Correlations for Five-Dimensional Model

Overload	1.000				
Clarity	-.032	1.000			
Conflict	.702	.000*	1.000		
Teamwork	-.099	.590	-.007	1.000	
Standardization	.222	.931	.051	.742	1.000

*Correlation fixed at .000 in the model.

Exploratory Principal Component Analysis

Exploratory analysis showed seven components with $\lambda > 1.00$. However, only the first four components fell outside the 95% confidence interval for this combination of number of items and sample size in Cota et al.'s (9) Monte Carlo analyses ($\lambda = 1.39 > 1.38$, the interpolated critical value for the fourth component; $\lambda = 1.21 < 1.33$, the interpolated critical value for the fifth component).

Four- and five-component solutions were examined to understand the structure of the items. The five-component solution showed that four of six overload items had their largest loadings on one component. Five of seven ambiguity items defined a second component. Four of five teamwork items defined a third component. Four of five conflict items defined a fourth component. Thus, for those four constructs, 17 of 23 items had their largest loadings on the hypothesized dimensions.

The hypothesized model broke down on the fifth component. This component was defined by only two items, one from the overload scale and one from the teamwork scale. Two ambiguity items had large secondary loadings on the fifth component, but one loading was positive, while the other was negative. The most important fact, however, was that none of the standardization items loaded on this component. Instead, two standardization items loaded on the overload component with the remaining three items distributed one item each across the ambiguity, conflict, and teamwork dimensions.

A four-component solution was examined to determine how the items would be represented in this model. The structure was closely comparable to the results for the first four components in the five-component solution. The primary difference was that component loadings tended to be slightly higher when fewer components were selected.

These analyses showed that four components could be identified which approximated the conflict, overload, ambiguity, and teamwork constructs. The standardization items were distributed across those four dimensions. The structure is shown in Table B-3 with loadings greater than .400 in bold.

Table B - 3. Principal Component Structure of the Stress Items

Item	Role Clarity	Role Conflict	Teamwork	Overload
Work fast	.008	.135	.033	**.655**
Time Pressure	-.026	.155	-.071	**.669**
Always More	.047	.338#	-.142	**.500**
Difficult keeping up	.015	**.421**	-.030	**.481**
Work after hours	-.226	**.483**	-.031	.315#
Too much pressure*	.101	.319#	-.029	.336#
			.	
Know what to accomplish	**.625**	.038	.059	.083
Know what is expected	**.686**	-.138	.117	-.021
Tell how to use time*	.308#	.083	.332#	.100
Responsibilities defined	**.661**	-.070	.121	.049
Orders clear	**.506**	.189	.203	-.065
Rules/decisions clear	**.672**	-.073	.121	.079
Clear how training fits*	.230	-.399#	.048	.246
Things done differently	-.049	**.653**	-.004	.164
Conflicting orders	-.020	**.574**	-.189	.158
DIs conflict	-.079	**.599**	.048	.081
Go agains rules	.210	.381#	**-.425**	-.246
Conflicting policies	-.068	**.653**	.208	.066
Recruits cooperate	.178	-.006	**.692**	-.081
Team goals	.53	.055	**.655**	-.048
Share information*	.336#	-.009	.217	.068
Work together well	.168	.061	**.710**	-.106
Willingly work as group	.170	-.090	**.691**	-.002
Always follow standards	.193	.035	**.487**	.204
Done "by the numbers"	-.022	.004	.140	**.488**
One way to do things	.283	-.061	.035	**.409**
Procedures spelled out	**.565**	-.153	.166	.108
Rules/regulations rigid	-.131	**.513**	.069	.071

.300 < Loading < .400

* No loading of .400 or higher.

Note. See text for details of the procedures used to select the number of components to extract.

Reviewing the results of the exploratory principal components analysis, the items that did not load on their hypothesized dimensions were understandable. The role clarity items that formed a component dimension were ones which addressed clear specification of goals, responsibilities, rules, and decisions. The general content of the items emphasizes having the organization spell out clearly what is required to achieve acceptable performance. Having procedures clearly spelled out was a potential standardization item that fit well with that theme. The only other candidate item concerned information-sharing among recruits, again a logical means of defining responsibilities.

Role conflict was defined by items which were primarily concerned with policies and procedures. The item dealing with potential pressure from other recruits was a marginal indicator for conflict; this item perhaps is viewed more as an indicator of negative teamwork. The policy/procedures focus also was reflected in the standardization item that loaded on this component. Rigid rules and regulations were related to conflict, presumably because there were instances where two or more rules and regulations might apply. If those rules and regulations are rigid and would lead to different courses of action, the experience would be role conflict.

Teamwork included four items that dealt with recruit cooperation in task performance. Sharing information had only a weak loading on this component, but always following standard operating procedures loaded substantially on this component. The latter result is not an obvious finding, but may indicate that the clearly defined procedures in basic training emphasized teamwork and cooperation.

Overload consisted of four items which dealt with the volume and pace of work. The item pertaining to having too much pressure tended to load on this dimension, but had a comparable loading on the role conflict dimension. Pressure could contribute to conflict if a person got behind on tasks and then had to choose between them. However, the most informative element of the analysis may have been that having only one way to do things and doing them by the numbers contributed to the feeling of overload. Perhaps recruits felt that taking shortcuts would be a means of relieving some workload. Step-by-step procedures followed to the letter would prevent this method of coping with overload.

Confirmatory Factor Analysis Comparison of the Four- and Five-Factor Models

The initial measurement model included five factors. The revised measurement model includes only four, but provides a better account of the covariation between responses to different stress items. The χ^2 for the five-dimensional model was 636.90 compared to 533.81 for the four-dimensional model. The four-dimensional model fit the data better by all three goodness-of-fit indices (NFI = .759 vs. .712; TLI = .885 vs. .821; CFI = .839 vs. .896). The four-dimensional model achieved this improvement in fit despite the fact that it used two fewer parameters to reproduce the data (degrees of freedom = 343 vs. 341).

CONCLUSIONS

Previous research had demonstrated that reasonable multi-item scales for role clarity, role conflict, and overload could be constructed from this item set (1). The primary new finding from these analyses, therefore, is that items originally intended to measure standardization may be effective indicators of these three target stresses. The set of teamwork items did not contribute any plausible extensions of the original scales.

The revised content of the scales suggests that slightly revised definitions may be in order for some scales. Role clarity is defined by how well procedures and responsiblities are defined. How those procedures and responsibilities fit into the organization as a whole is unimportant, and it appears that other recruits are not important in defining the demands of training. In effect, this makes role clarity a product of the formal organizational role spelled out as part of training. Informal role negotiation among the recruits does not appear to be a major contributor to this stress. Role conflict, too, appears to be purely organizational in content as the relevant items have to do with the nature of policies and communications from the training staff. The addition of an item indicating the presence of rigid rules and regulations underscores these factors as sources of conflict. Role overload is an indicator of time pressure and a high volume of required work, but the addition of items dealing with doing things by the numbers and only one way emphasizes the influence of formal training policies on this stress. Building on these observations, revised scales can be suggested for the target stresses (Table B-4). Testing these suggested revisions and extending the work to include the new items developed for this project will be primary objectives in the next phase of the work.

Table B - 4. Suggested Scale Content Based on Factor Analysis

Role Clarity

Recruits know what they are supposed to accomplish in recruit training.

Recruits know exactly what is expected of them.

Recruits' responsibilities are clearly defined.

Orders and explanations are clear about what has to be done.

Rules and decisions are clearly explained.

Procedures are spelled out in detail and followed closely.

Role Conflict

Recruits have to do things that should be done differently.

Recruits receive conflicting orders about what to do from different instructors.

Recruits have to do things in a way that is acceptable to one instructor but not another.

Recruits work under conflicting policies and regulations.

The rules and regulations during boot camp are too rigid.

Overload

Recruits are always working on rush jobs and having to work very fast.

Training is always a tight schedule with pressure to get things done on time.

There are so many assignments that there is always more to do no matter how much gets done.

There is so much work, recruits have difficulty keeping up with it.

Everything is done "by the numbers."

There is only one way to do a thing around here.

CONFIRMATION IN U.S. NAVY RECRUIT FIREFIGHTING TRAINING

The next phase of the research will evaluate the proposed measures of stress and self-efficacy in the current firefighting training program. One objective will be to determine whether the results obtained with the U.S. Marine Corps recruit data generalize to U.S. Navy recruits. While it is reasonable to expect the model to generalize, there is room for uncertainty. The Marine Corps data pertained to perceptions of basic training as an overall experience. The Navy data will pertain to a specific component of training encountered in the early part of the overall training process. These differences plus the possibility of general differences in the general training practices in the two recruit populations could modify the structure of stress.

The second objective will be to evaluate new items. These include the new role stress items written specifically to deal with firefighting training and the efficacy items.

The general study design will consist of administering the Initial Firefighting Stress Questionnaire (Appendix B-1) to U.S. Navy recruits. The questionnaire will be administered to approximately 150 females and 150 males. Half will complete the questionnaire early in firefighting training and half will complete it at the end of firefighting training. The data analyses will parallel those used in the confirmatory and exploratory analyses reported here. Further details of the planned study are available from the author on request.

The current status of the work is that the data collection protocol has received human protection approval as an exempt project. Permission to administer the questionnaire has been requested from the Office of the Chief of Naval Operations (OCNO) as required by current policy. The Recruit Training Command has been contacted and initial plans for data collection reviewed with them. Once OCNO approval is received, it is anticipated that data collection will take place in November 1997.

AFFECTIVE STRESS INDICATORS

Background

The research proposal called for mood assessment using the Profile of Mood States (10). This instrument is a 65-item questionnaire which yields six mood scales. Given changes in the training program and corresponding changes in the overall research design, a shorter instrument measuring two general dimensions of mood, positive and negative affect, should be adequate. The rationale for this change and the development of brief measures of positive and negative affect are described here.

Issues

Project developments since the time of the initial proposal have raised several issues which affect decisions about how to measure mood in this study. These issues are briefly reviewed here as background for the development of shorter measures.

Length

Practical considerations include testing time. This time will be limited. The POMS includes 65 items. Experience with a similar 40-item mood questionnaire (11) in U.S. Navy and Marine Corps recruit populations indicates that recruits have no problem answering the questionnaire. The 40-item questionnaire took about four to five minutes to complete. This time estimate applies to recruits who were familiar with the instrument. It would be reasonable to add approximately one or two minutes for completion when recruits are unfamiliar with the instrument. Adding 20 items would increase the completion time by approximately 50%. The result is a test that takes between 7 and 10 minutes to complete. That estimate applies only if the time taken to complete the instrument is controlled by reading the items to recruits. If recruits complete the questionnaire at their own speed, a small, but sizable, proportion will take much longer than 10 minutes to complete this instrument. The POMS might, therefore, require 15 minutes to administer.

Scale Redundancy

The length of the POMS is affected by the assumption that a number of specific mood states have to be measured (e.g., depression, vigor). Several items then are required for each mood to ensure that the scale assessing that mood has acceptable reliability. If fewer moods were measured, fewer mood items would be needed. Measuring fewer moods is a viable option.

One extensively debated issue in mood assessment is whether specific moods such as anxiety, depression, anger, or happiness should be measured individually or should be regarded as composites of two general dimensions (12). The general dimensions have been referred to as hedonic tone (i.e., positive vs. negative) and arousal (i.e., high vs. low). In the two-dimensional framework, specific moods are combinations of the two basic dimensions. For example, depression is negative hedonic tone with low arousal; anxiety is negative hedonic tone with high arousal; and happiness is positive hedonic tone with high arousal. Some supporters of the two-dimensional model have claimed that this model captures all or virtually all of the true variance in responses to mood questionnaires (12). Even the POMS authors have considered the possibility that mood profiles can be represented by two dimensions (13). The outcome of these inquiries has been the development of mood measures based on two higher-order dimensions, typically positive affect and negative affect (14,15). Much of the length of the POMS, therefore, may consist of redundant items measuring overlapping mood constructs.

Lack of Specific Hypotheses

Measures of specific moods would be mandatory if the study hypotheses predicted effects on specific moods. For example, depression must be measured if it were hypothesized that exposure to role modeling reduces depression. However, the hypotheses for this study refer to general effects of treatments on stress. In this case, measures of general mood dimensions will suffice provided these measures are sensitive to stress effects. Prior work suggests that this condition is met in basic training (16).

Conclusion

The above considerations indicate that although the use of the POMS was a reasonable plan when the project was first developed, changing to a simpler assessment is preferable now. Time constraints and cost weigh against the POMS.

Two-Dimensional Approach

The revised approach to mood assessment focuses on affect measures that will assess the overall stressfulness of the situation, rather than specific moods. A two-dimensional model is considered for this purpose. The utility of this model for studies of stress in recruit training has been demonstrated by Vickers and Hervig (16), who found that:

A. Reliable two-dimensional models of mood can be constructed for basic training. A two-dimensional model was constructed from 33 items of a standardized mood questionnaire (11). The two-dimensional factor solutions were very similar over time for the recruit sample. When a two-dimensional model was extracted for mood data gathered at six different times during basic training, the coefficient of congruence, a measure of factor similarity with a maximum value of 1.00 (absolute), averaged .97 for one factor and .98 for the second. Values in excess of .80 generally are accepted as indicating reasonable matches between factors, while values in excess of .90 represent very good matches. The two-dimensional model, therefore, was highly robust over time in a sample of Marine Corps recruits.

B. The model generalizes from recruit training to other populations. The factor structure generalized from the recruit sample to two Fleet Marine Force samples as indicated by coefficients of congruence in excess of .91. The two dimensions were the same ones identified in other populations as well. Comparisons to other two-dimensional mood models in the literature produced coefficients of congruence ranging from .83 to .99. These coefficients are in the excellent range for the generalization to other Marine Corps settings and in the good to excellent range when compared to results from civilian populations. The model, therefore, showed excellent generalizability relative to these other populations and settings.

C. Scale polarity is not an issue. The question of whether moods should be represented by unipolar scales or bipolar scales has been extensively debated. A unipolar scale would reflect increasing amounts of a single attribute, such as negative affect. A bipolar scale would reflect a range from positive to negative, such as positive affect to negative affect. Bipolar scales are preferred by some researchers on conceptual grounds. However, bipolar dimensions typically can be identified in factor analyses of mood items only if scores are ipsative. Ipsative scores are created by determining the mean and standard deviation of mood item scores for each individual, then using that information to standardize his or her item scores. The result is that the response to a given item is not expressed in terms of an actual level, but in the level relative to the average response for that person. It is the within-person frame of reference for scoring the items that defines an ipsative measure. In the case of mood measures, ipsative scores produced the same factors as raw scores. The ipsatized scores did produce bipolar dimensions. Vickers and Hervig (16) found that the raw score and ipsatized approaches described the same mood space (i.e., the same mood differences) using different origins to quantify mood. The net result was that the difference between the two models is superficial. Mathematically equivalent descriptions of differences between people are provided with both models.

D. Scale validity is not an issue. Two dimensions extracted the valid stress-related variance in mood responses. Scores on the two dimensions differed between groups that presumably had differences in stress. Mood was more negative for recruits who attrited than for recruits who succeeded in training. Mood levels also differed between training platoons. Stepwise discriminant analyses showed that no individual mood was a significant predictor of attrition status after controlling for the two dimensions. A similar analysis showed that depression was the only significant predictor of platoon membership. Even the relationship to depression was statistically significant only for the unipolar ($p < .04$) model. The bipolar representation produced a marginally significant ($p < .06$) result.

The evidence from that earlier study indicates that a two-dimensional solution is feasible, reliable, generalizable, and valid. There was little basis for choosing between the unidimensional and bipolar models.

Evaluation of the Two-Dimensional Approach

The possibility of using a two-dimensional mood model in the current project was evaluated using data from previous studies of U.S. Navy recruits. While the prior evidence suggested that the two-dimensional model would generalize to U.S. Navy recruits, it was desirable that this inference be tested. The key questions were: How well would a two-dimensional model account for mood data in this setting? Which mood items should be used to assess mood in the present study? The approach to answering these questions consisted of two major elements:

> ***Monte Carlo Criteria for the Number of Dimensions.*** One issue was whether earlier work by Ryman et al. (11) had extracted too many dimensions. An initial evaluation of this question was provided by using recent Monte Carlo criteria (9) to evaluate the structure of mood reports. Prior research generally has relied on Kaiser's criterion ($\lambda > 1.00$) to determine the number of factors to extract. Recent work suggests that this criterion often will result in the extraction of too many factors.
>
> ***Comparison of Alternate Structures.*** Evaluation also compared the two-dimensional solution to the more complex six-dimensional solution routinely applied to the Mood Questionnaire. Bentler's (17) EQS program provided the tests of alternate models. The comparison considered how well the data were reproduced by the model, including allowances for differences in the degrees of freedom utilized in each model.

Samples

Two samples of male U.S. Navy recruits who volunteered to participate in studies of risk factors for infectious disease provided data. Sample A consisted of 471 recruits; Sample B consisted of 363 recruits. Missing data on mood items caused the analysis sample size to vary from 375 to 471 in Sample A and from 341 to 363 in Sample B.

Mood Measures

The study participants completed the 40-item Mood Questionnaire (11) on a weekly basis. Recruits were asked to indicate how they had felt during the past three days. Responses were made using a five-point Likert scale with response options from Not at all to Extremely. The questionnaire was administered first during an in-processing period two or three days prior to beginning the formal training schedule. The questionnaire then was administered at weekly intervals during training. The data analyzed here were taken from the first administration and from the administrations in the third and fourth weeks of training. The latter times were chosen because firefighting training took place at that time.

Analysis Procedures

Exploratory principal components analyses were performed with the SPSSX (18) computer package. Structural equation models were analyzed with Bentler's (17) EQS program. Details of the analyses are provided in the Results section.

Results

Principal Components Analyses

The six data sets produced variable results with four to six components satisfying Kaiser's criterion ($\lambda >$ 1.00). The most common result was a five-component solution which occurred in three of the six analyses.

The Cota et al. (9) criteria indicated that at most three components should be extracted. The fourth component was associated with l values of 1.21, 1.24, 1.29, 1.37, 1.40, and 1.32 for the Sample A and Sample B administrations in order. Using Cota et al.'s (9) table for 35 variables, the critical values for these components were 1.48, 1.43, 1.43, 1.49, 1.50, and 1.43, respectively. Thus, the fourth component did not satisfy the Monte Carlo criterion in any of the analyses.

The third component generally satisfied the Cota et al. (9) criteria. The λs for this component were between 1.50 and 1.99. Five of the six values exceeded the Monte Carlo criterion. The sixth value was close to the Monte Carlo criterion ($1.50 < 1.57$).

The recurrent existence of a third substantial component to the mood reports does not necessarily identify a reliable dimension of mood. The content of that third component could be different in every analysis. However, examination of the factor solutions indicated that the third component was defined by loadings for a consistent set of variables. Based on this evidence, a three-component solution was considered in the confirmatory factor analysis.

Confirmatory Factor Analysis

The confirmatory factor analyses compared a two-dimensional mood model to three- and six-dimensional models. The items assigned to each dimension in the two- and three-dimensional models were determined by matching components across the six principal components analyses. The average loading on each component was determined for each item. The item was assigned to that component for which it had the largest average loading. The scaling for the latent trait dimensions was established by fixing the variance of the trait at 1.00.

The results supported a six-dimensional model, but left the two-dimensional model as a reasonable alternative (Table B-5). The six-dimensional model accounted for more covariation between items than did either a two- or three dimensional model. This inference derives from comparison of the goodness-of-fit indices. These indices can be interpreted roughly as the proportional reduction in the original covariance between items that is achieved by fitting the model to the data. The different indices vary with regard to how they handle the variance that a model would be expected to explain by chance alone.

For the present purposes, two important points derive from the indices. One point is that they all give the same rank order of fit for the models. Each criterion, therefore, leads to the conclusion that the six-dimensional model fits the data best. The second point is that the fit index for the two-dimensional model has roughly the same proportional size when compared to the best-fitting model for all three indices. Considering the CFI, the average statistic for the two-dimensional model explained an average of

approximately .832 compared to .915 for the six-dimensional model. The TLI produced values of .857 vs. .907. The NFI produced values of .778 and .858. Considering the ratio of the index for the two-dimensional model to that of the six-dimensional model, these figures yield 90.9%, 94.5%, and 90.7%. Thus, the two-dimensional model accounts for better than 90% of the covariation that can be explained by the six- dimensional model.

Table B - 5. Mood Measurement Model Summary

	df	χ^2	NFI	TLI	CFI
Sample A					
Day 3					
Null	630	12377.85			
Two	593	2760.82	.777	.804	.815
Three	591	2423.89	.804	.834	.844
Six	579	1813.69	.853	.886	.895
Day 4					
Null	630	12579.28			
Two	593	2812.48	.776	.803	.814
Three	591	2541.48	.798	.826	.837
Six	579	1731.00	.862	.895	.904
Sample B					
Day 3					
Null	630	7461.76			
Two	593	1708.46	.771	.827	.837
Three	591	1467.56	.803	.863	.872
Six	579	1079.80	.855	.920	.927
Day 4					
Null	630	7674.48			
Two	593	1625.92	.788	.844	.853
Three	591	1429.30	.814	.873	.881
Six	579	1054.55	.863	.927	.932

Note. df = degrees of freedom for the model. NFI = Bentler and Bonett's (19) normed fit index. TLI = Tucker and Lewis' (20) index. CFI = Comparative Fit Index.

Examination of the latent trait correlations provides additional reason to believe that a two-dimensional model is a reasonable substitute for more complex alternatives. The two-dimensional model consisted of what amounted to dimensions of positive and negative mood. These latent traits were moderately correlated (Table B-6). The addition of any further dimensions means that two or more latent traits are included which are very highly correlated. Addition of a third latent trait to the model split the negative mood dimension into two highly correlated dimensions. The further division of the items into the six latent trait dimensions identified by Ryman et al. (11) showed a strong positive correlation between the positive mood indicators of Happy and Active and strong positive correlations between the remaining four negative mood indicators. Thus, two dimensions were only moderately correlated, but any further breakdown into more specific mood dimensions produced highly correlated latent traits. The six-dimensional model can be summarized by noting that the pattern of correlations suggests two clusters of latent traits, one comprising the positive moods and one comprising the negative moods.

Table B - 6. Latent Trait Correlations for Altenative Models

Two-Dimensional						
Active/Happy	1.00					
Depression/Fear/ Anger/Fatigue	-.47	1.00				
Three-Dimensional						
Depression/Fear	1.00					
Active/Happy	-.47	1.00				
Anger/Fatigue	.86	-.44	1.00			
Six-Dimensional						
Active	1.00					
Happy	.91	1.00				
Anger	-.37	-.43	1.00			
Fear	-.33	-.40	.73	1.00		
Depression	-.43	-.50	.80	.86	1.00	
Fatigue	-.44	-.41	.78	.67	.75	1.00

Note. Scale labels reflect the assignment of items comprising a dimension in Ryman et al.'s (11) scales.

The confirmatory factor analysis results can be summarized best by postulating a hierarchical structure for mood. The top of the structure might be occupied by a general positive-negative hedonic tone dimension. This possibility is suggested by the moderate negative correlation between the latent traits for positive and negative affect. Positive and negative affect would be the second level of the hierarchy. The six specific moods would be the third level.

Adopting a two-dimensional model for mood assessment is equivalent to focusing on the second level of this hierarchy. The second level of the hierarchy provides a reasonable basis for assessing mood in this study. This level of the hierarchy can be addressed with two scales rather than six. The two scales involved account for much of the common variance among mood items. In fact, comparing the goodness-of-fit indicators in Table B-6, the two-dimensional model accounts for about 90% of the covariation explained by the six-dimensional model.

The remaining 10% of the covariation may reflect only subtle nuances of mood that are irrelevant for this project. The variance captured by the two dimensions probably can be expected to include all or nearly all of the mood differences between treatment groups in this project. This inference is an extrapolation

from Vickers and Hervig's (16) earlier demonstration that two dimensions effectively summarized group differences between attrition groups and between platoons. Thus, two dimensions should summarize the mood effects of the experimental treatments adequately.

Component Structure

If a two-dimensional mood model is adopted, scales must be constructed for those dimensions. The results of the principal components analyses were used to select items for this purpose. Table B-7 presents the items with the highest average component loadings for these analyses. The 12 highest loadings have been noted for each of the first two components. These loadings tended to be higher for the first component ($.709 < \lambda < .771$) than for the second component ($.569 < \lambda < .774$), but the highest loadings were comparable for each component.

Not surprisingly, the components identified in the present analyses were the same as those in the Vickers and Hervig (16) study. he items in the negative column 10 of 13 items with loadings of .600 or greater on the positive affect dimension in the earlier analyses. The items in the positive column represent 10 of 11 items with loading of .400 or better in the earlier analyses.

Table B - 7. Average Principal Components Analysis Loadings for Selected Mood Items

Negative	1	2	Positive	1	2
Depressed	.771	.720	Cheerful	.774	.738
Blue	.766	.678	Energetic	.752	.807
Miserable	.760	.712	Happy	.747	.708
Angry	.757	.656	Good	.723	----
Sad	.750	.737	Pleased	.704	.708
Annoyed	.747	.663	Lively	.702	.783
Downcast	.745	.678	Satisfied	.675	.664
Uneasy	.745	.719	Active	.657	.747
Grouchy	.745	.617	Vigorous	.631	.679
Low	.743	----	Alert	.600	.652
Burned Up	.714	----	Steady	.572	----
Irritable	.709	.640	Content	.569	.497

Note. Items listed are those with the highest average component loadings in this analysis. Column 1 shows the loadings in this study. Column 2 shows the loadings in Vickers and Hervig's (16) study of Marine Corps recruits. Seven items in the Mood Questionnaire were omitted from that study.

Recommended Mood Assessment

The mood measures in this study will be used to test the hypothesis that the Advance Organizer and Role Model treatments will reduce stress. This objective apparently can be satisfied by measuring positive and negative mood. Measuring more than two mood dimensions is useful if the objective is to account for covariation between mood item scores. The measurement of additional dimensions has had little or no value in explaining differences between groups that vary in presumed stress exposures in the past (16). There is no *a priori* reason to believe this result would change dramatically in the present setting. Thus, there is little risk that employing a two-dimensional model of mood will omit critical emotional reactions to stress. This risk is acceptable in light of the substantial reduction that can be achieved by shifting to this simplified mood model.

The recommended mood assessment consists of 12 items measuring two general dimensions of positive and negative affect. The 12 items were selected to provide broad coverage of the specific moods assessed in the six-dimensional mood model. The set of items includes indicators from five of the six Mood Questionnaire scales developed by Ryman et al. (11). The fatigue domain has not been included. The items are:

Negative Mood: Depressed, Blue, Sad, Angry, Annoyed, Uneasy

Positive Mood: Cheerful, Happy, Satisfied, Energetic, Active, Vigorous

The proposed scales have acceptable reliability. Coefficient a estimates for the negative affect scale were .910 and .905 for data obtained during the third and fourth weeks of Study A. The negative affect coefficients for Study B were .887 and .903. The corresponding coefficient a estimates for the positive affect scale were .874, .893, .823, and .821. Higher reliability could be obtained by adding more items to the scales, but values above .800 generally are acceptable for research (21). hus, the scales will be brief, but sufficiently reliable to assess general differences in affective trends in the treatment groups.

RESEARCH DESIGN ISSUES

Developments during the first year of the project have affected the research design in several ways. It has been necessary to change the overall design structure to bring it in line with the current organization of firefighting training at the Recruit Training Command (RTC). The frequency of stress measurements has been reduced as a result of limitations on the computer resources available to the project. The assessment of performance has been extended to include hands-on firefighting tests developed by the RTC. Finally, closer examination of the training at Fleet firefighting schools combined with the changes in the research design in recruit training have made it necessary to drop the Fleet test of treatment efficacy. The rationale for each modification is summarized in the following paragraphs.

Experimental Design

The original experimental design called for a 2 x 2 x 3 Advance Organizer x Role Model x Hierarchical Level research design. The Advance Organizer and Role Model elements of the design represented the experimental instructional treatments to be developed in the study. The two levels of the design for each instructional treatment were Not Exposed or Exposed to that treatment. The Hierarchical Level factor was based on the fact that people occupy different levels in the organizational hierarchy in shipboard firefighting. This initial design was to be implemented with only female recruits as the subjects of study. Stress indicators were to be measured three times during firefighting training.

Revised Design

The revised research design is a 2 x 2 x 2 Advance Organizer x Role Model x Sex research design. The hierarchical level element of the original design was dropped because it is part of the shipboard firefighting structure, but not part of the structure of basic training. Sex was added to the design because female recruit divisions now are paired with male recruit divisions. Paired divisions follow the same training schedule. Any attempt to separate the male and female recruits would require major changes in the standard training schedule. The effort required for this separation would substantially increase the problems the study poses for the training staff at the RTC. Also, RTC policy requires that any potentially beneficial instructional aids or other techniques or procedures that might improve performance be made available to both male and female recruits. Including both sexes in the study will permit an evaluation of the likely impact of the new training tools on the overall recruit population. This impact must be known

to evaluate the expected payoff from implementing the new tools as part of training once the study is completed.

A further alternative to the original design has been developed to prepare for possible scheduling problems. The alternative is a 3 x 2 Treatment x Sex research design. This design has been considered to anticipate the problems that could arise if there is too little time in the training schedule to administer both treatments to a subset of the recruits in the study. Basic training is designed to cover the wide range of topics needed to transform recruits from civilians to sailors. The objective is to accomplish this transformation with the greatest efficiency possible. he result is a very tight training schedule with little free time. In this context, the Advance Organizer and Role Model treatments each will require a significant block of time to administer. The original research design called for some recruits to receive both treatments, while other recruits received only one treatment, and some recruits received no treatments.

Given the tight training schedule, it may be impossible for any recruits to receive both treatments. If so, the alternative 2 x 3 Gender x Treatment design will be used. In this case, the experimental groups would consist of Advance Organizer (only), Role Model (only), and No Treatment (control) groups. Shifting to this design would mean the loss of the opportunity to determine whether the different treatments had additive or interactive effects. This information could be important for applied decisions regarding whether to implement one treatment or both to obtain the best training outcomes. However, the revised design will provide a basis for stating whether either or both of the treatments improves training performance. The issue of combined effectiveness then may be a follow-on topic that can be investigated quickly and inexpensively if the RTC wishes to do so.

Revised Timing of Stress Measures

The original research plan called for repeated measures of stress indicators, including mood scales. Measurements were to be obtained near the beginning of firefighting training, after exposure to the experimental treatment but before hands-on firefighting, and after hands-on firefighting. The original plan assumed that recruits would be in the computer laboratory often enough to permit these measures to be administered and recorded by computer.

Paper-and-pencil data collection is the alternative to computer data collection. Given the time required to administer a questionnaire, repeated measurements become a logistic problem for this mode of administration. Repeated interruptions in a tight training schedule could severely compromise cooperation with the project. In addition, paper-and-pencil administration involves much more personnel time not only to administer the questionnaires, but to enter the data into data bases, check the data, and otherwise prepare for data analysis.

The personnel-intensive nature of the paper-and-pencil tests and the time required to administer them have shifted the testing procedure to a post-test-only assessment. This approach will be somewhat less sensitive to treatment differences than would have been the case with repeated measures. Any stable individual differences in stress will remain part of the error term in the analyses, rather than being removed as a between-persons score component. However, power analyses suggest that post-test-only designs should be adequately sensitive to substantial differences between the groups. Analyses of other variables such as intelligence test scores, age, education, and other demographic attributes will be added to the study to determine whether the experimental groups were composed of comparable recruits. If so, it will be reasonable to assume that the stress levels and affect were comparable prior to exposure to the treatments. This additional evaluation also will increase the personnel resource requirements of the recruit training component of the study.

Performance Assessment

Performance measures will be obtained from standardized tests given in basic training. These scores include results of academic tests and new hands-on performance tests. The original plan to include performance measures from post-basic training Fleet firefighting school will have to be dropped from the study.

Academic Tests

Test scores for the current academic tests were obtained for 243 recruit divisions undergoing firefighting training in 1997. Only division averages were available, but this was sufficient to show that female divisions scored lower on the average than male divisions (Female Average = 42.57; Male Average = 43.87). This difference is small in absolute terms, but it must be remembered that the figures are based on average scores for groups of 50 to 80 recruits. As a result, the standard deviations of the score distributions were small. For this reason, it is informative to note that the observed difference translates to a moderately large effect size (ES). Using the standard deviation for the sample of male divisions as the denominator in the computations ES = 0.60. Expressed in other terms, the difference is statistically significant ($t = 2.95$, $p < .001$). Overall, the difference is classified as a medium effect size. Work by other researchers has shown that firefighting academic scores are related to Armed Forces Qualifying Test Scores (AFQT; Slater, personal communication). Controlling for AFQT, therefore, should increase the precision of the estimates of differences between males and females when the analysis is conducted at the level of individual recruits. If there are differences in the average AFQT scores for females and males, controlling for AFQT could increase or decrease the size of the estimated differences between the groups. The effect will depend on the direction of the AFQT differences between females and males.

The academic tests for firefighting have been modified recently. Past evidence, therefore, provides a qualitative picture of the differences between female and male recruit divisions that should generalize to the new test. The generalizable qualities of the test are that AFQT scores still should be a useful covariate, and women may continue to do slightly less well than men on the tests. The strength of the AFQT-performance association and the magnitude of sex differences in performance cannot be quantified at this time.

Hands-on Performance Measures

The RTC has developed additional performance measures during the past year. The hands-on component of firefighting training is now graded on a pass-fail basis. The performance measures specify in a step-by-step fashion the actions required to fight the fires that recruits encounter in this controlled training environment. The success of the team is determined by whether or not the required actions are performed in the proper sequence. The pass-fail decision applies to firefighting teams, not to individuals.

The hands-on performance measures can be analyzed with teams as the unit of observation. Whether a team passes or fails the performance test can be recorded. The proportion of teams passing the test then can be determined for divisions that received the Advance Organizer, Role Model, both, or neither. The proportions then can be compared using standard procedures such as the χ^2 test or tests for differences in proportions comparing the treatment groups to the control group.

The new procedures have been in use only a short period of time, so there is too little information available to determine base rates of success and to work out the number of teams that would have to be studied to permit meaningful inferences about the hands-on performance effects of the training interventions. These elements of the study will have to be worked out during implementation of the study design.

Fleet Firefighting Training

The original research plan called for a follow-up of trainees who received the experimental treatments. The objective was to determine whether the interventions affected learning and performance closer to the job site. In particular, the intent was to measure performance at Fleet firefighting training to determine whether the treatments affected the individual's readiness to master more advanced firefighting skills.

This element of the project cannot be implemented for several reasons. Firefighting school adopts a different approach to learning and evaluation. In this school, the students are instructed, then asked to fight controlled fires. Evaluation takes the form of correction when mistakes are made during the procedures and debriefing to discuss how things could have gone differently. The academic tests that are given are not recorded. The firefighting itself is done as a member of a team. For these reasons, there are no firefighting scores available for individuals.

Consideration was given to developing team scoring methods. This approach is impractical because teams would include mixtures of some people who received one treatment, some who received another, and some who received both (if that option can be implemented). In addition, most or all teams would include some people who went through basic training prior to the introduction of the interventions. Thus, it would be very unlikely that any one team would consist solely of people who received the Advance Organizer, for example. Collecting a large number of homogenous teams would be an extremely difficult task. Furthermore, the likelihood of an all-female team would be extremely small. The preceding considerations lead to the conclusion that follow-up assessment at Fleet firefighting is not a reasonable undertaking.

Obtaining Recruit Training Command Measures

The Recruit Training Command has significantly increased computer support for tracking and monitoring training progress in the past several years. The current system records abilities and academic test performance. These scores are readily available provided appropriate steps can be taken to obtain access to them.

The key issue is whether individual identifiers will be needed to pair the data from the academic files with those from other sources. Analyses of the general effects of interventions can proceed without the individual identifiers. Recruit divisions are likely to be the unit of sampling for treatment administration. Thus, the data can be extracted for all individuals within a division without asking for individual identifiers. If roughly the same proportion of recruits from each division attend the intervention sessions, this approach will provide treatment estimates that are roughly comparable for comparisons between interventions. The comparisons will be biased downward slightly when comparing treatment and control groups because some in the treatment group will effectively be controls (i.e., will have missed the session and, therefore, not be exposed to the treatment). The exact magnitude of this problem will be studied in more detail as the treatments are implemented.

Individual identifier data will be needed whenever stress assessments must be matched to performance. In this case, the key issue will be to ensure that informed consent is given by the participants prior to collecting the stress assessment data. That informed consent must grant permission to obtain the necessary information from training records. With this permission, there should be no problem obtaining the data.

Psychometric Evaluation of the Recruit Training Measures

A technical psychometric evaluation of the academic performance data is not appropriate. Such evaluations typically focus on considerations of measurement precision (i.e., reliability), factor structure, and other similar criteria. These criteria are relevant to the measurement of psychological constructs which involve a single dimension of individual differences (e.g., depression, stress). In these cases, it is reasonable to assume that response differences between individuals reflect differences in the strength or quality of the underlying psychological processes that give rise to the behaviors and feelings referred to in the items. The items are chosen to reflect those underlying processes, so some degree of coherence (i.e., correlation) among the indicator variables is expected. The absence of that coherence is reason to question the validity of the scale.

Academic achievement measures do not fit the standard psychometric model, except in special cases. Suppose, for example, that a course involved learning several different principles and their applications. The probability of getting the correct answer to two different questions then will depend on whether the questions draw on the same principle. If different people master different principles, there may be little correlation between questions involving different principles. On the whole, the correlation between getting one question right and getting another question right may be quite small because different principles were involved in many item pairs. For this reason, standard psychometric models are of limited value in evaluating academic tests. In short, the validity of an academic test does not rest on internal consistency of the measure.

Content validity is the major concern for an academic test. Does the test accurately reflect mastery of the material that is being taught? If so, the test is valid in the most important sense given the purpose for which it was constructed. The content validity of the academic tests has been reviewed extensively by U.S. Navy educational experts within the past two years to ensure that it maps onto current course content. The nature and content of questions and the instructional content of the firefighting course have been reviewed to ensure that the training meets the objective of preparing recruits to fight fires in the fleet. This review was conducted by U.S. Navy subject matter experts who have endorsed the existing test as an accurate representation of the academic content of the firefighting course. Based on this review, the academic tests are valid indicators of mastery of the knowledge required for firefighting.

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Appendix B-1

Initial Firefighting Stress Questionnaire

PERCEPTIONS OF FIREFIGHTING

You are being asked to participate in a study entitled "Development of a Stress Questionnaire for Firefighting Training" under the direction of Dr. Ross R. Vickers, Jr., of the Naval Health Research Center, San Diego, CA. This study is part of a larger project to develop improved methods of instruction to better prepare recruits for firefighting in the fleet.

Your participation in the study must be voluntary. If you choose not to complete the questionnaire, there will be no penalty or loss of rights to which you are otherwise entitled. If you have questions, please ask them now.

Division _____ Training Day _____

Instructions

For each question, please circle the appropriate response to describe how you see firefighting training at this time. Response options are:

[SD] Strongly Disagree	[D] Disagree	[N] Neither Agree nor Disagree	[A] Agree	[SA] Strongly Disagree

1.	I always know which tool or procedure to use.	[SD]	[D]	[N]	[A]	[SA]
2.	In firefighting, recruits have to do things in certain ways that could be done differently.	[SD]	[D]	[N]	[A]	[SA]
3.	Recruits cooperate well on firefighting tasks.	[SD]	[D]	[N]	[A]	[SA]
4.	Recruits always follow standard firefighting procedures.	[SD]	[D]	[N]	[A]	[SA]
5.	Recruits have to work very fast.	[SD]	[D]	[N]	[A]	[SA]
6.	I have the ability to succeed in firefighting training.	[SD]	[D]	[N]	[A]	[SA]
7.	I know the firefighting performance standards expected of me.	[SD]	[D]	[N]	[A]	[SA]
8.	Conflicting orders from different people are common in firefighting.	[SD]	[D]	[N]	[A]	[SA]
9.	Recruits stress teamwork during firefighting.	[SD]	[D]	[N]	[A]	[SA]
10.	All firefighting tasks are done "by the numbers."	[SD]	[D]	[N]	[A]	[SA]
11.	It is easy to remember the technical details of firefighting.	[SD]	[D]	[N]	[A]	[SA]
12.	I can overcome firefighting problems by trying harder.	[SD]	[D]	[N]	[A]	[SA]
13.	Other recruits sometimes want you to take shortcuts instead of following standard procedures.	[SD]	[D]	[N]	[A]	[SA]
14.	Team communications are clear and specific.	[SD]	[D]	[N]	[A]	[SA]
15.	Recruits share information effectively in firefighting.	[SD]	[D]	[N]	[A]	[SA]
16.	Firefighting procedures are spelled out in detail and followed closely.	[SD]	[D]	[N]	[A]	[SA]
17.	You can succeed on even hard firefighting tasks if you stick with it.	[SD]	[D]	[N]	[A]	[SA]
18.	Firefighting rules or procedures often are in conflict, so recruits are uncertain what to do.	[SD]	[D]	[N]	[A]	[SA]
19.	Explanations about what has to be done are clear.	[SD]	[D]	[N]	[A]	[SA]
20.	There is no team friction or disagreement while firefighting.	[SD]	[D]	[N]	[A]	[SA]
21.	Team leaders make good, quick decisions.	[SD]	[D]	[N]	[A]	[SA]
22.	Doing well in firefighting training is difficult no matter how hard you try.	[SD]	[D]	[N]	[A]	[SA]
23.	It is clear how firefighting training fits into the Navy.	[SD]	[D]	[N]	[A]	[SA]

24.	Each recruit willingly does his/her firefighting job.	[SD]	[D]	[N]	[A]	[SA]
25.	Any recruit who does poorly in firefighting has too little ability.	[SD]	[D]	[N]	[A]	[SA]
26.	Recruits often are confused over who is supposed to do which firefighting task.	[SD]	[D]	[N]	[A]	[SA]
27.	Success in firefighting training depends on how hard I try.	[SD]	[D]	[N]	[A]	[SA]
28.	It is difficult to keep up with the tasks that must be done.	[SD]	[D]	[N]	[A]	[SA]
29.	Team member responsibilities are clearly defined.	[SD]	[D]	[N]	[A]	[SA]
30.	There is only one way to do each firefighting task.	[SD]	[D]	[N]	[A]	[SA]
31.	My goals in firefighting training are clear.	[SD]	[D]	[N]	[A]	[SA]
32.	Any recruit who fails firefighting just is not trying hard enough.	[SD]	[D]	[N]	[A]	[SA]
33.	Success in firefighting is a matter of luck.	[SD]	[D]	[N]	[A]	[SA]
34.	Orders given during firefighting are clear.	[SD]	[D]	[N]	[A]	[SA]

Item Content for Scales

Role Clarity (Ambiguity)

7. I know the firefighting performance standards expected of me.

19. Explanations about what has to be done are clear.

23. It is clear how firefighting training fits into the Navy.

29. Team member responsibilities are clearly defined.

31. My goals in firefighting training are clear.

34. Orders given during firefighting are clear.

Role Conflict

2. In firefighting, recruits have to do things in certain ways that could be done differently.

8. Conflicting orders from different people are common in firefighting.

13. Other recruits sometimes want you to take shortcuts instead of following standard procedures.

18. Firefighting rules or procedures often are in conflict, so recruits are uncertain what to do.

Teamwork

3. Recruits cooperate well on firefighting tasks.

9. Recruits stress teamwork during firefighting.

15. Recruits share information effectively in firefighting.

20. There is no team friction or disagreement while firefighting.

24. Each recruit willingly does his/her firefighting job.

Standardization

4. Recruits always follow standard firefighting procedures.

10. All firefighting tasks are done "by the numbers."

16. Firefighting procedures are spelled out in detail and followed closely.

30. There is only one way to do each task.

Overload

5. Recruits have to work very fast.

28. It is difficult to keep up with the tasks that had to be done.

Efficacy

6. I have the ability to succeed in firefighting training.

12. I can overcome firefighting problems by trying harder.

17. You can succeed on even hard firefighting tasks if you stick with it.

22. Doing well in firefighting training is difficult no matter how hard you try.

25. Any recruit who does poorly in firefighting has too little ability.

27. Success in firefighting training depends on how hard I try.

32. Any recruit who does poorly in firefighting training is not trying hard enough.

33. Success in firefighting is a matter of luck.

Additional Items

11. It is easy to remember the technical details of firefighting.

14. Team communications are clear and specific.

21. Team leaders make good, quick decisions.

Appendix B-2

Prototype Stress Assessment Profile

Division _____ Training Day _____

Instructions

For each question, please circle the appropriate response to describe how you see firefighting training at this time. Response options are:

[SD] Strongly Disagree	[D] Disagree	[N] Neither Agree nor Disagree	[A] Agree	[SA] Strongly Disagree

1.	I always know which tool or procedure to use.	[SD]	[D]	[N]	[A]	[SA]
2.	In firefighting, recruits have to do things in certain ways that could be done differently.	[SD]	[D]	[N]	[A]	[SA]
3.	Recruits cooperate well on firefighting tasks.	[SD]	[D]	[N]	[A]	[SA]
4.	Recruits always follow standard firefighting procedures.	[SD]	[D]	[N]	[A]	[SA]
5.	Recruits have to work very fast.	[SD]	[D]	[N]	[A]	[SA]
6.	I have the ability to succeed in firefighting training.	[SD]	[D]	[N]	[A]	[SA]
7.	I know the firefighting performance standards expected of me.	[SD]	[D]	[N]	[A]	[SA]
8.	Conflicting orders from different people are common in firefighting.	[SD]	[D]	[N]	[A]	[SA]
9.	All firefighting tasks are done "by the numbers."	[SD]	[D]	[N]	[A]	[SA]
10.	It is easy to remember the technical details of firefighting.	[SD]	[D]	[N]	[A]	[SA]
11.	I can overcome firefighting problems by trying harder.	[SD]	[D]	[N]	[A]	[SA]
12.	Team communications are clear and specific.	[SD]	[D]	[N]	[A]	[SA]
13.	Firefighting procedures are spelled out in detail and followed closely.	[SD]	[D]	[N]	[A]	[SA]
14.	You can succeed on even hard firefighting tasks if you stick with it.	[SD]	[D]	[N]	[A]	[SA]
15.	Firefighting rules or procedures often are in conflict, so recruits are uncertain what to do.	[SD]	[D]	[N]	[A]	[SA]
16.	Explanations about what has to be done are clear.	[SD]	[D]	[N]	[A]	[SA]
17.	Team leaders make good, quick decisions.	[SD]	[D]	[N]	[A]	[SA]
18.	Doing well in firefighting training is difficult no matter how hard you try.	[SD]	[D]	[N]	[A]	[SA]
19.	Any recruit who does poorly in firefighting has too little ability.	[SD]	[D]	[N]	[A]	[SA]
20.	Recruits often are confused over who is supposed to do which firefighting task.	[SD]	[D]	[N]	[A]	[SA]
21.	Success in firefighting training depends on how hard I try.	[SD]	[D]	[N]	[A]	[SA]
22.	It is difficult to keep up with the tasks that must be done.	[SD]	[D]	[N]	[A]	[SA]
23.	Team member responsibilities are clearly defined.	[SD]	[D]	[N]	[A]	[SA]
24.	There is only one way to do each firefighting task.	[SD]	[D]	[N]	[A]	[SA]
25.	My goals in firefighting training are clear.	[SD]	[D]	[N]	[A]	[SA]
26.	Any recruit who fails firefighting just is not trying hard enough.	[SD]	[D]	[N]	[A]	[SA]
27.	Success in firefighting is a matter of luck.	[SD]	[D]	[N]	[A]	[SA]
28.	Orders given during firefighting are clear.	[SD]	[D]	[N]	[A]	[SA]

Feelings During Firefighting Training

Below is a list of words describing moods and feelings. Please indicate how each word describes how much you have had these moods and feelings during firefighting training. Circle or mark the appropriate response using the following scale.

[1] = Not at all
[2] = A little
[3] = Moderately
[4] = Quite a bit
[5] = Extremely

Depressed	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Vigorous	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Cheerful	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Uneasy	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Blue	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Satisfied	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Angry	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Active	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Sad	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Annoyed	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Happy	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**
Energetic	**[1]**	**[2]**	**[3]**	**[4]**	**[5]**

Appendix B-3

Details of the Approach to Job Analysis

DETAILS OF THE APPROACH TO JOB ANALYSIS

The research design called for a job analysis using Fleishman's (22) job analysis inventory. This inventory develops a profile based on more than 20 abilities. When the project was implemented, review of this initial decision raised several concerns about using this methodology. The basic practical concern was raised by considering a worst case outcome. This outcome would be that all of the abilities in Fleishman's (22) model were needed to describe the firefighting tasks. If so, more than 20 items would have to be included in the stress questionnaire just to measure ability demands. The resulting questionnaire either would be very long or would include very few indicators of subjective stress other than ability demands.

Conceptual problems provided a related set of concerns. The various abilities in Fleishman's (22) model may be identifiable when extensive ability test profiles are analyzed (e.g., Carroll, 23), but raters may not be capable of providing the same level of detail. Instead, ratings may represent only a few general dimensions. This possibility is consistent with the results of recent studies showing that ratings of different attributes tend to be highly correlated. Substantial correlations have been found when ratings were used to analyze U.S. Navy jobs (24) and when ratings have been used to analyze individual tasks (25). The possibility that individual abilities organize into a few higher-order dimensions is important. The finding that psychometric 'g' captures nearly all of the predictive power of a wide range of scales assessing intellectual abilities (26) may be a model for other domains. Perhaps a few higher-order dimensions provide a satisfactory approximation to what would be obtained with a much more detailed assessment that included a number of largely redundant scales.

The concerns described here were the basis for a decision to simplify the rating procedure for firefighting training. Simplified versions dealt with only five major ability domains defined by Reynolds et al. (24). Eliminating item redundancy by moving to a higher level of abstraction in the ratings should make the rating task less difficult. The increase in ease of completion should be obtained without excessively decreasing the amount of information obtained.

Two advantages follow from this approach. Fewer items will make it easier to incorporate the results into stress assessment. Beyond this, a shorter rating instrument seems likely to lead to a loss of rapport between the researcher and the respondent who is now faced with a lengthy, repetitive, and, therefore, boring task.

The practical and empirical problems with obtaining extensive task analysis ratings led to the adoption of a simpler approach based on Reynolds et al.'s (24) factor analysis of ability ratings for 75 entry-level U.S. Navy jobs. That analysis reduced 21 specific abilities to five higher-order ability factors:

Physical ability included ratings of strength, flexibility, stamina, and balance. *Cognitive ability* encompassed ratings of reasoning, numerical ability, pattern detection, originality, information ordering, problem sensitivity, and visualization. *Dexterity* included dexterity, speed of movement, arm-hand steadiness, and coordination. *Perceptual skill* included reaction time, sound localization, vision, and speed of perception. *Communication* included oral and written communication. Factor loadings for individual abilities on their respective factors were distributed as follows:

> .90	1
.80 - .90	7
.70 - .80	4
.60 - .70	4
.50 - .60	2
.40 - .50	3

These loadings indicate that, in general, individual items were closely identified with their respective factors. Only one secondary loading exceeded .40 (speed of perception on the cognitive ability factor). An oblique rotation was employed, but correlations between factors were modest ($.10 \leq r \leq .39$). These results suggest that five general dimensions can be used to extract the majority of the variance in much more detailed job analyses. A simple rating form based on these five dimensions was developed and is provided on the following page.

ABILITY DEMANDS OF RECRUIT FIREFIGHTING

You are being asked to participate in a research study entitled "Ability Demands in Recruit Firefighting." The study objective is to identify the difficulties that might cause stress for recruits in firefighting training. This study is part of a project that will develop and validate new tools for training recruits in firefighting.

Your participation in the study must be voluntary. Involvement should take about five minutes. The questionnaire is anonymous, and there are no known risks to you from participating. You will not benefit directly from completing the questionnaire, but future recruits and instructors may benefit from improved training technology.

If you choose to participate, please mark the appropriate response for each item below to describe how difficult the demands on that ability are for recruits in firefighting training. Use the following scale:

Not very Difficult [1]	**Somewhat Difficult** [2]	**Difficult** [3]	**Very Difficult** [4]	**Extremely Difficult** [5]

Communication

The ability to speak clearly and to understand English words and sentences — **[1] [2] [3] [4] [5]**

Cognitive Ability

The ability to understand, organize, and solve problems and to invent unusual or creative solutions when necessary — **[1] [2] [3] [4] [5]**

Dexterity

The ability to make quick coordinated movements, particularly ones involving the hands and fingers — **[1] [2] [3] [4] [5]**

Perceptual Skill

The ability to accurately compare numbers, letters, or other stimuli, to localize sounds quickly, and to react rapidly to all such stimuli when they are action signals — **[1] [2] [3] [4] [5]**

Physical Ability

The ability to use muscles to exert force, to work without getting out of breath, to maintain one's balance, and to bend, stretch, twist, etc., — **[1] [2] [3] [4] [5]**